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Traffic Density in Philippines Not Enough to Justify More Expensive Roads
By J. L. HARRISON

System at Navy Yard Handles Large Emergency Contracts with Dispatch and Accuracy

Ocean Terminal of Norfolk & Western Expanded by Building of Two New Warehouse Piers
By F. P. TURNER

EDING WOODEN SHIP CONSTRUCTION As the Accoma Left the Ways, Derricks Swung to Place the First Keel Timbers for the Next Ship

Kreolite Lug Wood Blocks
"The Paving that's Saving"

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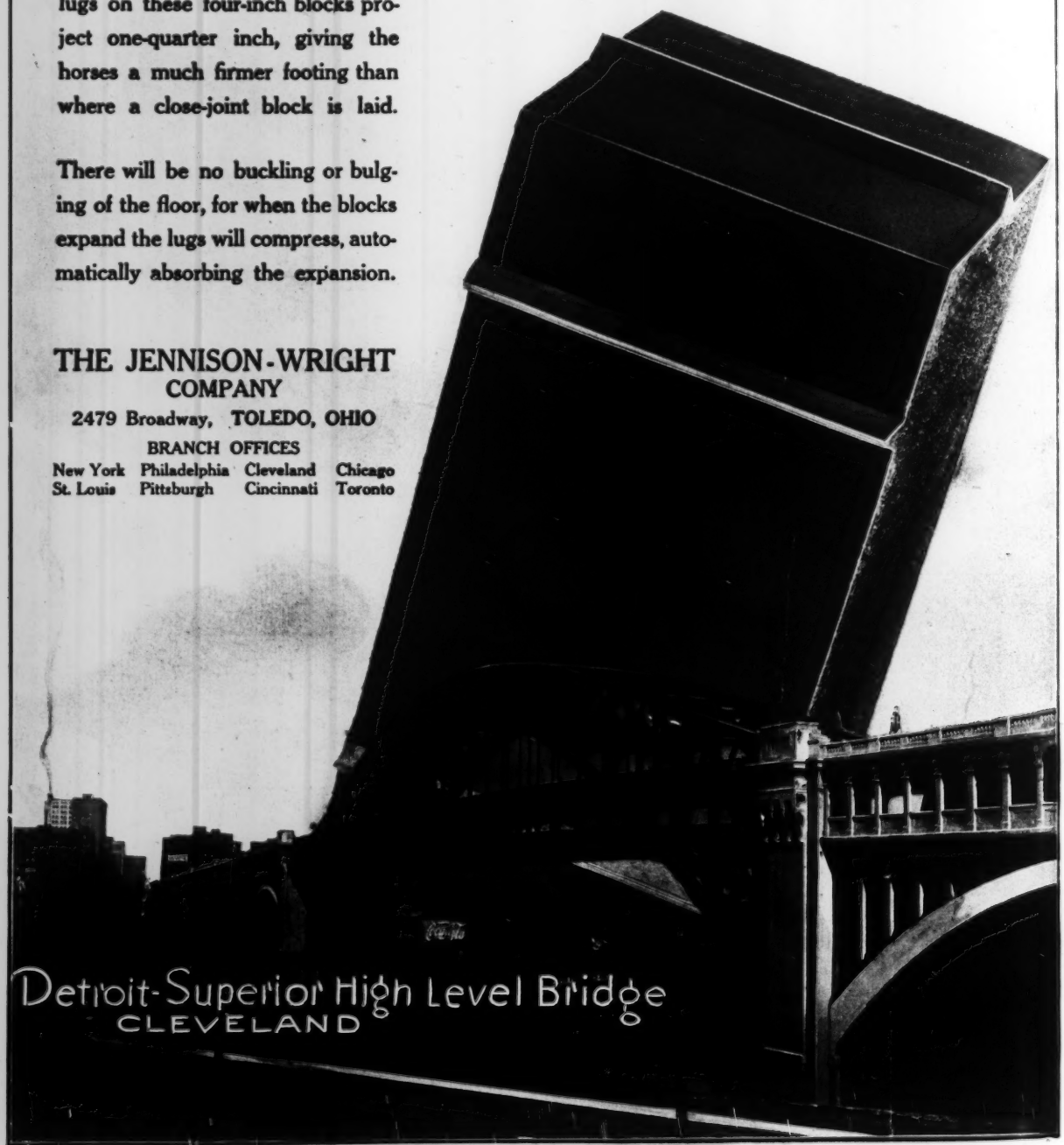

Detroit-Superior High Level Bridge
CLEVELAND

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

Volume 80 — NEW YORK, THURSDAY, MAY 16, 1918 — *Number* 20

The Cantonment Division "Made Good"

WE HEAR much of government inefficiency. Some time ago the papers were full of comment on the lagging of the Ordnance Department program, and now we are realizing that the aircraft program has failed miserably. But when these instances come to mind do we remember that the Cantonment Division "made good?" It got an order to build 16 cities in three months, and it did it. There has been criticism of inefficiency, of overpayment, of labor. But the chief consideration was speed, cost was secondary. The cantonments *were delivered on time.*

Reason for Construction Speed

ONE naturally inquires as to the reason for speed—which here is efficiency—in cantonment construction, whereas ordinance and aircraft have suffered delay. There are many reasons, but the primary one is that the officers of the Cantonment Division (now called the Construction Division) understood production. The regular army officers in charge were open-minded and gave full rein and hearty backing to able construction men from civil life who were accustomed to "putting things through." In the production of aircraft and ordnance much of the difficulty has been due to insistence upon getting the very best. The production man will content himself with something less than perfection, but will make deliveries on schedule. The production idea must be paramount in such a business as war. Any gun that will kill is better than no gun when the burglar is coming through the window.

Archaic Statistics

MUCH railroad history has been made since 1916. A year ago we entered the world war. The railroads, in an attempt to handle a phenomenal traffic under adverse conditions and help win the war, voluntarily put their affairs into the hands of a war board. The obstacles were too great, and late in December the Government took the railroads in charge for the period of the war. Now, four months later, the Interstate Commerce Commission issues a pamphlet of railroad statistics for the year 1916—not the 800-page volume ultimately to be issued, but a 12-page abstract of *advance* information, "for the press." But how many readers of the press care now for pre-war statistics? Already annual reports of railroads for 1917 are appearing, but even these are brushed aside for the figures for the first months of Government operation. And if we are interested in the 1916 figures, will we remember that conditions since eclipsed by the war produced abnormal earnings in that year, and refuse to misinterpret these figures? Although statistics such as these obviously cannot be assembled and presented in a day, a year and a half is a long while in war times.

Borglum and Airplane Production

WHETHER or not the sensational controversy now going on over Gutzon Borglum's charges results in discrediting Mr. Borglum or some officers of the government is of small consequence beside the fact that this country has not yet produced airplanes of any type in sufficient quantities for military purposes. The facts involved in this direct charge against the War Department are admitted by everyone, including the officials themselves. The investigation of the Department of Justice, confined to ascertaining whether any criminal act has been committed will be of no help in getting airplanes. The Senate committee's investigation, however, may do much if it answers these questions. Were adequate steps taken to construct airplanes in quantity? Were proper engineering methods used in seeing that production kept up with expectations? Was the lag, if so detected, brought to the attention of those in authority? Were measures then taken to remove difficulties and increase production? The answers to these questions will disclose the weak spot in the production machinery.

Ship Contract Changed From Fee to Lump Sum

ALTHOUGH retrogressive in form, the recent action of Mr. Schwab in changing the contract of the Submarine Boat Corporation from a fee to a lump-sum basis is really progressive in operation. The whole theory of the fee system of contracting as now in operation between large private firms and the most important construction companies is that the construction company is able to perform the work with the greatest economy of time and money, that its services are valued in proportion to this ability and its reputation, and that the owning company pays for those services on a fee basis. In other words, there is complete confidence on the part of the owner that the contractor will give him the best to be had and will do the work in the most efficient manner. This confidence, based on the reputation of the contractor, has been entirely lacking between the government and the contractors for the ships to be

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produced under the fee-contract system. Naturally, without this confidence the system has failed in many cases. It would fail on private work if this confidence were lacking. Mr. Schwab's action in reverting to the lump-sum form is in reality evidence of the confidence felt by the Shipping Board that the Submarine Boat Corporation will fulfill its contract. The action says in effect, "The Government knows that you can produce the ships. It will pay you a lump sum sufficient to guarantee you against market fluctuations and take its hands off, so that you will not be delayed by petty reviewings of all your actions." Inquiry into minute details and delays in giving authorizations are evidences of that lack of confidence which destroys the efficacy of the fee-contract system. If the government is to secure the results which private owners have realized under the fee system, it must show the confidence which the private owners have shown. Otherwise, the system breaks down. The contractor's reputation is worth nothing, because the government sets no store by it and does not trust the contractor by reason of it; and unless the government can give and the contractor enjoy a confidence proportional to this reputation, both are better off under the lump-sum contract, although it has been outgrown on private work.

Speed Up Railway Equipment Work

REPORTS state that one of the first acts of Mr. Schwab, on taking charge of the Government shipbuilding operations, was to order that no more alterations should be made in designs, but that construction must be pushed with the utmost speed on the designs already adopted.

It would be of vast benefit to the country if a similar keynote could be sounded in the Federal railway administration. The Government assumed control of the railways because of the urgent necessity that their traffic capacity should be made equal to the demands, and because the operation of all the lines as a single system offered possibilities of increasing traffic capacity that could not be attained under separate control by individual companies. But the Federal railway administration is in danger of neutralizing the gains due to the unified operation by losses in other directions.

The railway blockade of last fall and winter was due chiefly to three causes—congested terminals, shortage of cars and shortage of locomotives. Everyone knows that the railway companies ought to have ordered rolling stock last year. Financial considerations and the impending Government control prevented most of the companies from placing orders.

No responsibility was more imperative when the Federal railway administration took charge than that the car and locomotive shops of the country should be set to work at once to their utmost capacity to turn out all the rolling stock they could before the traffic congestion of next winter comes. But four precious months went by and not till this month did the Director-General place the orders for 100,000 cars and 1025 locomotives. These seem like large orders, but they will not be sufficient to make good the annual depreciation in existing rolling stock.

Of course there were weighty excuses for this delay. Plans and specifications were first prepared for standard cars and standard locomotives. Undoubtedly, there are advantages as well as disadvantages in such nation-wide standardizations; but every engineer who knows the time necessary to develop and adopt worthwhile standards, and the difficulties, which always last over a considerable period while the new standard is displacing former practice, will wonder whose judgment dictated that the building of new rolling stock should be delayed until standard designs were developed.

It is pretty well known now that delay for the development of standards is one of the reasons why our troops in France, as well as those training here, still lack much of the fighting equipment that ought to be in their hands. It is a misfortune for the country if the lesson is not yet learned at Washington that the time for developing standards is not when our enemy's guns are moving toward us, and every moment is precious.

There never could be a time when criticism of Government actions was voiced in more friendly spirit than now. Even those who oppose Government ownership and operation of the railways in peace times are today earnestly desirous that the present Federal railway administration of the railways shall be in the highest degree successful. It can be successful, however, only if those who are in responsible charge understand that centralization of control has its great dangers as well as its advantages; and that it is far more important at the present juncture to do things rapidly than to do them in the very best way.

There is no use now, of course, in wasting regrets because car and locomotive and rail orders were not placed months ago. It is important, however, that these past mistakes shall be realized in order that a different policy may be put in force. Every day's delay in putting the railway equipment work into full operation is a handicap to our military operations.

Saving Time in Shipbuilding by Use of Electric Welding

MANY have dreamed of the future possibility that riveting might be replaced by electric welding in the joining of structural steel members. Peace times never made it possible for these dreamers to obtain a trial, but war has given them the opportunity. The ship-welding test at Kearny, N. J., described on page 950, affords a far more elaborate trial than could have been hoped for prior to the present year.

It is not now of great moment that knowledge benefiting many practical processes will flow from this test. The sole justification for the test is that it may furnish a means for speeding up ship construction. Today we realize how all-important is time. We have not always realized it. Just a year ago this month the contest between steel ships and wood was in its early stages, and time was subordinated to other matters; the dispute that continued until September lost several months to shipbuilding. Whatever gives promise of regaining some of that lost time compels our immediate attention.

Yet any gain of time that electric welding may be able to bring about is a hope for the future rather than

something soon to be realized. Ships now on order can hardly be affected by the outcome of the test, whatever it may be. Their design and even their construction is far advanced. The present high-pressure rate of working promises virtual completion of the shop operations before the welding tests can affect actual construction. First use of the process, after it has proved its claims, must be on the ships that are to follow the hundreds of cargo vessels now being built.

The Kearny test is planned on a magnificent scale. Yet it is a laboratory test, a specimen test. It cannot duplicate actual service stresses, imposed by wind and wave. Not until a welded ship has been tried out at sea will final assurance of the service value of the process be had.

Data on the time saving secured through the use of electric welding must be deduced from the test, however, since time is the fundamental consideration. Such data can apply directly only to the middle section of the ship, the test being made on such a section. Here the difficulties of fitting and pulling the plates to place, as outlined by Mr. Mason in his report, do not appear. In the fabricated-ship construction now going on, the mid-section work has been found to be simple placing and riveting of successive pieces brought in by rail from the shops. Rivet holes have matched so perfectly that no delays in erection occur, and correspondingly no gain would be secured through the fact that the welding machine eliminates the matching of connections.

The time gained in assembling the curved work of the molded ends of the ship is thus seen to be the determining factor. Careful observation may, however, make it possible to glean the necessary information on this point from the experience of building the test section. Simultaneously, the building ways of all the large shipyards will be contributing experience on the ease or difficulty of erecting the bent frames and rolled and forged plates of the ship ends. If the most optimistic hopes of the fabricated-ship designers turn out to be well founded, the welding process will find it hard to compete with the processes now in use.

Recommendations of Railway Wage Board

GENERAL rather than specific reparation for the low level of pay received by railroad employees is embodied in the findings of the railway wage commission. Increases are recommended on the basis of existing compensation—or compensation at the beginning of 1916. The increases are based on a curve that is straight except for a few breaks; starting with a $20 advance for those receiving $46 per month, the maximum raise of $34 is reached for a present salary of $85, and then the increase drops regularly to nothing for the $250 man. No account is taken of the nature of the job; the $85 transitman and the $85 station agent fare the same, each receiving the maximum advance of $34. No plan, apparently, is offered to reward the employee who has shown marked improvement in the last two years as compared with his neighbor who has not. Organized workers, who have had substantial increases in these two years, may see little further help for them in the new schedule, while the men who have been receiving $3000 or more per year get nothing to offset the shrinking value of the dollar. But there was a crying need for immediate relief for railroad workers; the increases recommended are properly largest for the lower paid men, and these increases are so much more liberal than unorganized railroad employees have been accustomed to receiving that the mechanical nature of the plan will probably be readily forgiven, while the organized employees will see that they have no just grievance. It is to be hoped, however, that some latitude will be allowed to department heads in meting out the awards, and that further investigation will ultimately be made to determine the relative value of different classes of railroad work.

Start Motor-Truck Transportation Studies

THE article by J. L. Harrison, formerly of the Bureau of Public Works, Manila, P. I., on page 961 of this issue, on the motor-truck problem in the Phillippine Islands, is perhaps the first thorough study of the desirable capacity of motor trucks under a given set of conditions. The fact that most of the information in regard to the loads permissible on Philippine roads is negative, is unhappily a condition not peculiar to the islands. This lack of exact data for discussion emphasizes the contention of this journal that immediate investigation of this problem is imperative.

As shown by Mr. Harrison, the determining feature of the discussion is the gross tonnage that can be reasonably expected to be carried over the road. This, he states, would not in the near future exceed or approach 20,000 tons annually over any one road, and therefore he concludes that the money saved in transportation by operating five-ton trucks instead of one-ton trucks, which the present road will carry, would not pay for rebuilding and maintaining the roads for the heavier trucks. This conclusion appears to be supported by the facts presented, but it is needless to say that in districts such as we have in America, where traffic census has shown an annual tonnage of 150,000 carried by trucks, an entirely different conclusion would be reached.

Not only are the types of road to be built and the loads to be carried subjects for investigation, but exact data must be had as to the cost per ton-mile for trucks of various capacity. This varies greatly both for different weights and also for different types of road surfacing, but before the business of motor-truck transportation can be developed as an economic proposition, we should know just what kind of road surface will require the least power.

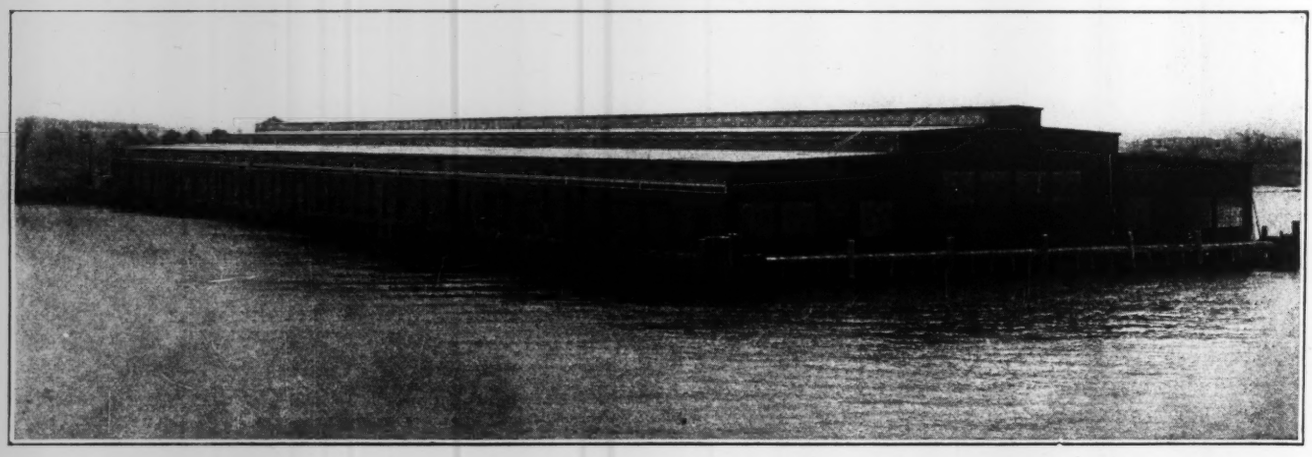
Again, starting with the assumption that gross tonnage is the determining factor, and accepting the conclusion of the writer that, to exceed the ultimate strength of a pavement will ruin it just as certainly as it will ruin a bridge, the question arises, What shall be done with the side roads? Shall all the roads be built the same, so that the concentrated load of the occasional heavy truck, which happens to go on the side road shall not destroy it, or shall a system of licensing, with prescribed zones, in which certain weights of trucks may operate, be employed?

These and other questions regarding the relation between the vehicle and the road must be answered before highway transportation can be said to rest on a sound economic basis.

Norfolk & Western Builds Terminal Piers at Norfolk

Timber Substructure with Steel-Frame Shed Selected as Best Type—Package Freight Handled to Ships on Movable Gangway Ramps

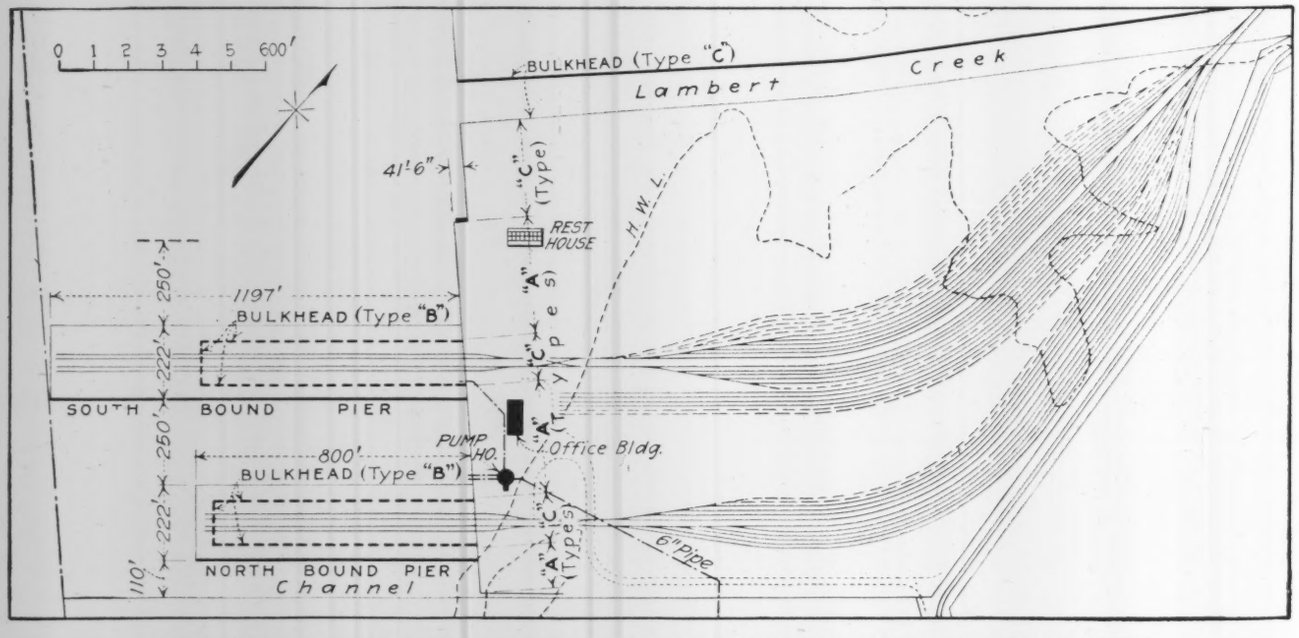
By F. P. Turner
Bridge Engineer, Norfolk & Western Ry., Roanoke, Va.



TWO OF THESE TERMINAL PIERS BUILT FOR TRANSFERRING FREIGHT AT LAMBERTS POINT

TERMINAL warehouse piers for the transference of freight from steamship to railway were completed last year for the Norfolk & Western Ry. at Lamberts Point, in the Norfolk, Va., district. Comparative studies of different types of structure were made and the one erected is thought to possess a number of points of superiority for the particular conditions to be met. It is, in addition, of peculiar interest in these days of the development of ocean shipping and warehousing equipment.

For a number of years the freight traffic, handling all classes of package merchandise offered for movement from Boston, New York, Philadelphia and Baltimore to interior points by way of Norfolk, Va., has increased to such an extent as to tax the warehouse room of different steamship companies having terminals at the latter port. From time to time additions have been made to warehouse space used for storage and transfer to meet the immediate needs of increased business. This has resulted in congestion, both for lack of space for warehouses and for sidetracks to reach them. The Norfolk & Western Ry. Co. is the principal carrier moving this freight to the interior and to reach the old steamer warehouses of the Merchants and Miners Steamship Co., Old Dominion Steamship Co., the Old Bay Line Steamship Co., and Clyde Line Steamship Co., it had to operate its shifting trains over one of the important and congested streets of Norfolk, in the wholesale district.



STEAMSHIP PIERS WITH ADJOINING RAILWAY YARDS PROVIDE FOR INCREASED BUSINESS

To relieve this congestion and the hazard of shifting cars over so many street crossings, a location was selected and two large steamer warehouses constructed on the property of the company, lying on Elizabeth River midway between Norfolk and Lamberts Point coal piers.

The warehouse yard tracks occupy a space immediately adjacent to the storage yard serving the railway's coal piers and terminal building. As shown in the general layout drawing the two new piers, carrying the warehouses, extend out into the deepwater channel and are approached by the classification and storage tracks which serve the warehouses, both inbound and outbound. The outbound, that is the northbound, freight is cared for on the southerly of the two piers, which is 800 ft. long and 222 ft. wide and carries a warehouse 208 x 750 ft. Freight from the north to be handled to the railway comes in on the northerly pier, which is 222 x 1200 ft.

LONG STEAMSHIP WAREHOUSE PIER HAS TRACKS, PLATFORMS, MOVABLE DOORS AND FIRE CURTAINS AT ROOF

in plan with a 208 x 1150 ft. warehouse. Slips all around the piers are from 28 to 30 ft. deep and 250 ft. wide, except on the south side of the 800 ft. pier, where there is only 110 ft. width.

The pier sites, as well as a large part of the area covered by tracks, were originally below high water line. To bring this area to a level on which it would support tracks, about 12 ft. above mean low water, it was necessary to construct timber bulkheads and fill behind them with material pumped by hydraulic dredge from the "dredged area" lying between the main river channel and the shore ends of the piers.

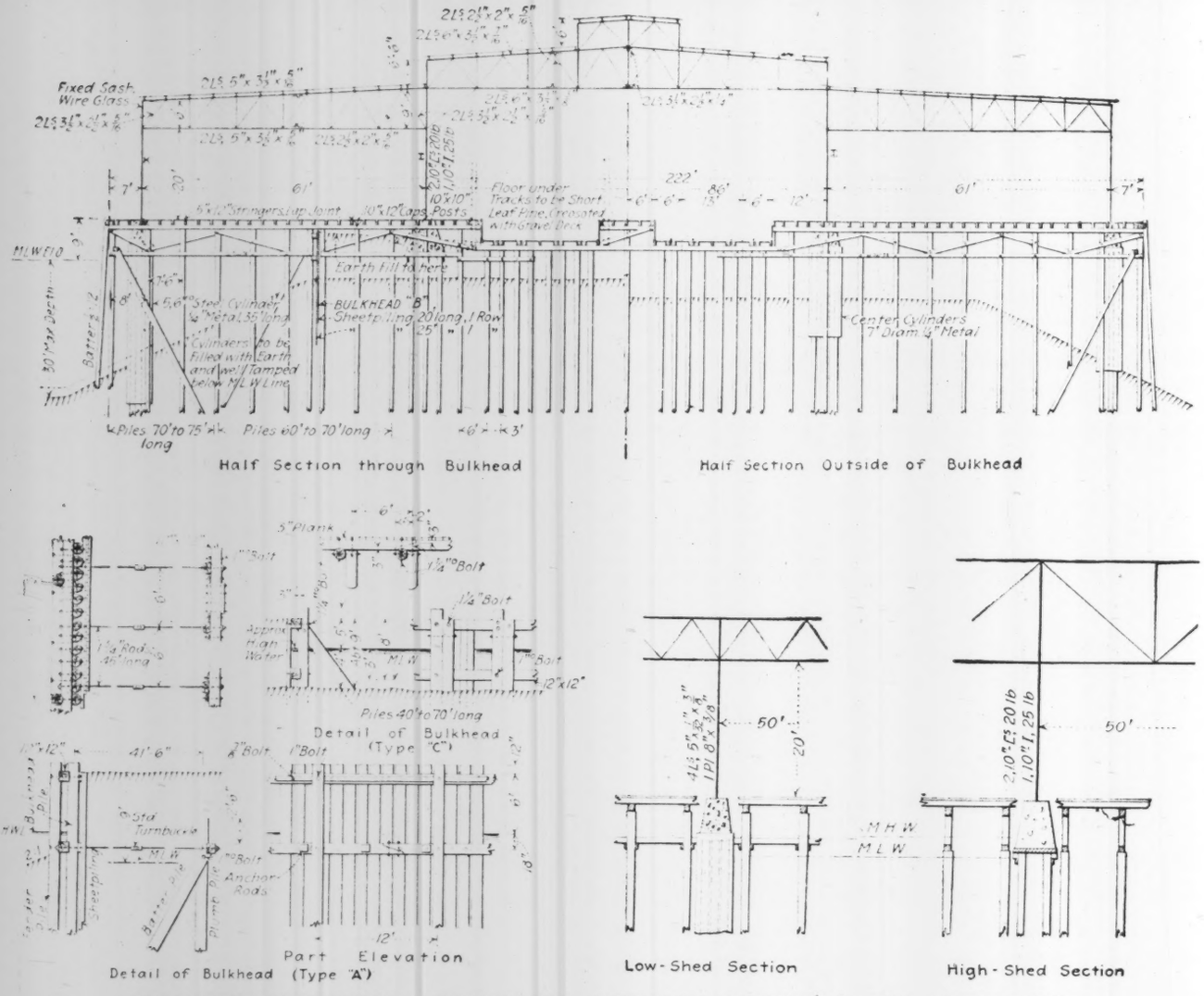
Two general types of bulkheads are used outside the piers proper as shown detailed on one of the drawings, and one other type under the piers. Bulkhead A was used across the head of the slips to retain the bank against deep water. It consists of a solid row of vertical piles, with two lines of horizontal wales and a double row of vertical sheet piles, anchored by tie rods to anchor piles 41 ft. 6 in. back of the bulkhead line. This type has met requirements satisfactorily.

Bulkhead C is used where shallow water is maintained to support embankments 9 ft. high. This type forms two sides of Lamberts Creek channel and incloses other large areas to be reclaimed. The earth pressure against this type of bulkhead is resisted by batter piles. The design has shown ample strength. Bulkhead B is used to retain the fill which forms the core of the pier.

The detail drawings showing the substructure of the pier were adopted after a very careful study of all the elements entering into the design of the pier for conditions obtaining at Norfolk. In this locality every permanent foundation must be supported on piles, driven well below the mud line, where concrete should begin in order to seal the timber from the teredo, so destructive in these waters.

Comparative designs were made for permanent pier substructure, using cylindrical concrete piers founded on piles cut off below maximum depth of water and having a concrete girder-and-slab deck, as against a precast concrete pile support with slab deck. The first method was abandoned on account of excessive first cost, due to the depth of water and the precautions to be observed to secure successful results with this type of foundation. The second method, using concrete piles, was entirely practicable, but tests showed that piles of unusual lengths would be required. Concrete piles of abnormal length are difficult to handle, and previous tests showed that piles ranging as high as 90 ft. in length would be required to sustain loads coming upon them, the weight of the piles themselves being a considerable item. This type of foundation therefore was not adopted.

The life of a warehouse pier depends upon the life of the substructure supporting the floor and pier-shed, the floor wearing surface and the roof. Creosoted piles have a record of service at Norfolk of 20 to 25 years, and are used almost exclusively for dock construction. After a thorough investigation of the first cost, annual repairs and life of various kinds of floors and roofs, it was de-


Fixed Sash, Wire Glass
Floor under Tracks to be Short Leaf Pine, Creosoted with Gravel Deck
Earth Fill to here
BULKHEAD "B"
Center Cylinders 7' Diam. 1/4" Metal
Cylinders to be filled with Earth and well Tamped below M.L.W. Line
Piles 70' to 75' long
Piles 60' to 70' long
Half Section through Bulkhead
Half Section Outside of Bulkhead
Detail of Bulkhead (Type "C")
Piles 40' to 70' long
Part Elevation
Detail of Bulkhead (Type "A")
Low-Shed Section
High-Shed Section
M.H.W.
M.L.W.

DESIGN COMBINES TIMBER SUBSTRUCTURE, EARTH FILL CORES AND STEEL FRAME SHEDS

termined that the type of construction selected should be such that the average life of the component parts would be the same.

The pier-shed, being of steel, will under normal conditions have double the life of substructure supporting the floor. The pedestals around the edge of the pier are creosoted piles protected by a steel cylinder, extending two to three feet below maximum depth of water and filled with earth. Experience on similar structures has led to the belief that steel cylinders will last 20 to 25 years and that creosoted piles, after exposure, will last equally as much longer.

The roof, floor and pile substructure may be renewed in sections after 20 to 25 years' service without taking down the steel trusses or interfering with the remainder of the pier. Since the renewal of the substructure would require the destruction of the floor and roof it was not considered advisable to select the more expensive concrete fireproof construction for these two elements, but to use materials having a normal service the same as the substructure.

Creosoted pile substructure was adopted for the entire pier area outside of the bulkhead line established by the War Department. Inside the bulkhead line it proved more economical to drive an uncreosoted bulkhead at the location shown upon the plan and fill it with dredged material for supporting the pier-shed floor and tracks. Creosoted posts, caps, bracing and floor stringers were used above the low-water line. A 3-in. white-oak floor, dressed on one side and two edges, was adopted for wearing surface, this type of floor having a record of long service in similar warehouses of this company. The roof selected was a 5-ply felt, pitch and gravel, laid on $1\frac{3}{4}$ in. tongue-and-groove yellow pine sheathing resting on steel purlins.

Dimensions and spacing of timbers and steelwork entering into the construction of these piers are indicated on the accompanying drawings. The loads assumed in the design are as follows:

Floor—500 lb. per sq.ft.
Roof—Purlins, 40 lb. per sq.ft.
Trusses, 50 lb. per sq.ft.
Piles—17 tons each.

The fiber stress in timber is 1500 lb. per sq.in., and tensile unit stress in steel 15,000 lb. per sq.in. For compression in steel the formula used was $16{,}000\text{-}70\ \frac{l}{r} =$ 14,000 lb. maximum.

Virginia-pine piles were used throughout for supporting the substructure; white-oak fender piles and

chock timbers were used along the outer edges for protection where vessels lie. Creosoted piles were generally 14 in. diameter two feet below butt with 7-in. points in lengths varying from 50 to 80 ft.; untreated piles driven inside the interior bulkhead B were 12 in. diameter two feet below butt with 6-in. points. All bulkhead piles were creosoted and of the larger size. Certain locations required piles 95 ft. in length to give satisfactory bearing resistance. These piles were obtained by splicing a creosoted pile to an untreated pile, using a square joint connected with a 1-in. steel dowel 2 ft. long, the splice being held with a solid band of 3 x 4-in. timbers 12 ft. long, securely spiked to the piles and wrapped with No. 14 wire.

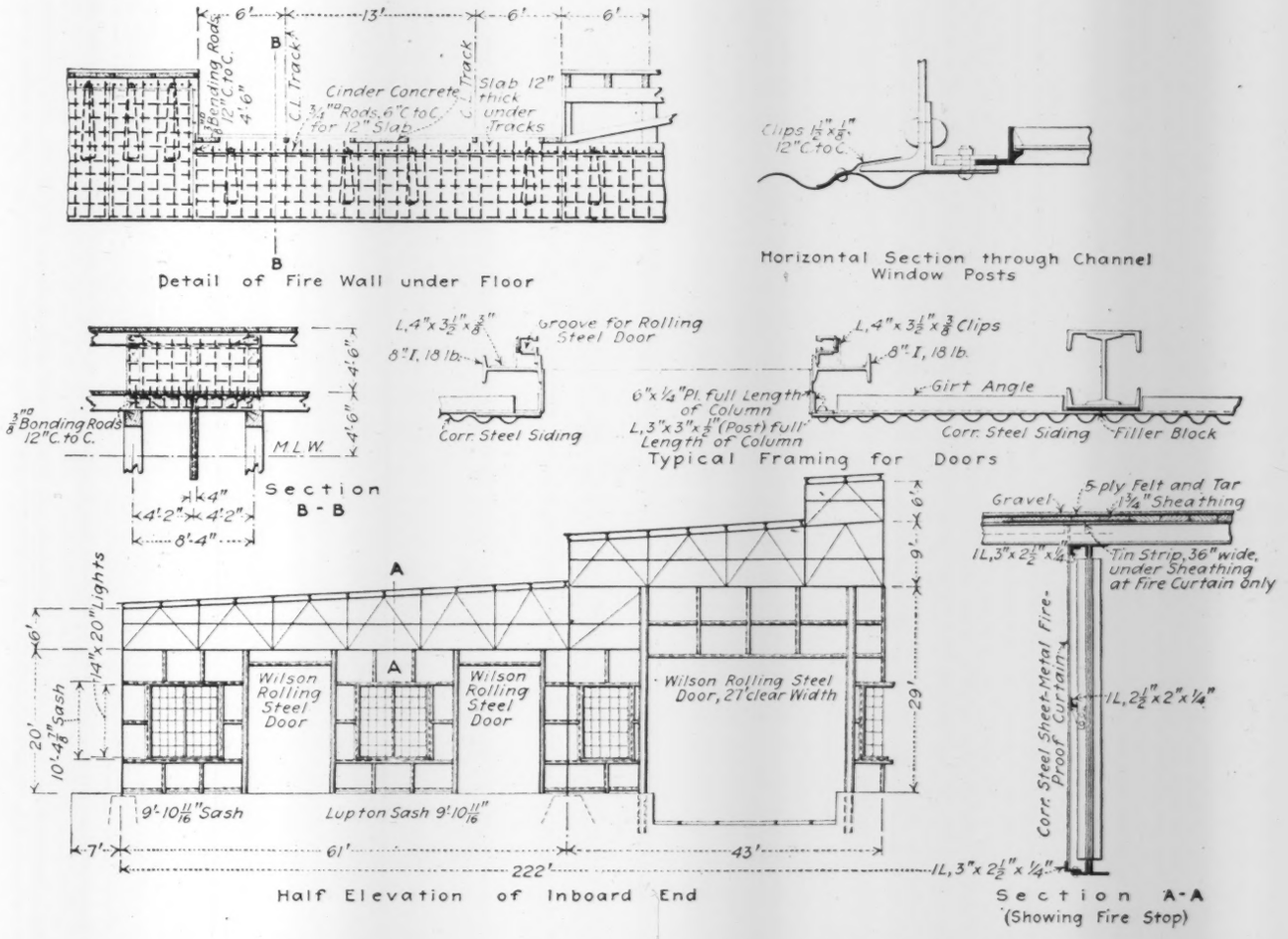
Sound square edge short-leaf pine lumber, creosoted with 12 lb. of dead oil of coaltar per cubic foot, was used for all exposed bracing and floor supports. Long-leaf yellow pine 3-in. floor, dressed one side and two edges, was used outside the building, white oak similarly dressed being used inside.

The sides of the piers were practically solid vertical steel rolling lift doors, the width and spacing being such that the doors of all vessels of different steamship companies using these piers will be accommodated. Three lines of windows, fitted with steel sash, wireglass, ventilators and operating device, are provided on either side for admitting light and ventilation. No. 22 gage galvanized corrugated steel siding covers the ends and sides, with the exception of window and door space. Galvanized cornice was used to finish along all eaves and gables, connecting with copper flashing at the edge of the roof. Gutters were formed in the roof sheathing and the water conducted through 10 x 10 x 7½-in. copper outlet boxes and 6-in. cast-iron downspouts to the river at 50-ft. intervals.

Four lines of concrete pedestals at 50 ft. intervals support the steelwork. The pedestals supporting side columns rest upon four creosoted bearing piles, driven in a steel cylinder 5 ft. 6 in. diameter and 35 ft. long. The piles were driven to carry 17 tons each and are cut off 2 ft. 6 in. above mean low water. After filling and tamping the cylinders with sand or other approved earth material a conical concrete pedestal was built on the piles to receive the column. The pedestals were reinforced and were constructed of 1:2:4 gravel concrete.

The pedestals supporting the center columns, outside the bulkhead B, were constructed in cylinders 7 ft. diameter, the length depending upon the depth of the water. Six creosoted bearing piles were driven in each cylinder. Inside bulkhead B rectangular concrete pedestals were constructed, supported by six untreated piles, driven to carry 19 tons and cut off 2 ft. above mean low water. Timber forms were used to secure the rectangular pedestals and concrete was not placed until the area within the bulkhead had been filled.

The specifications for pile-driving provided that a water jet should be used to secure the necessary penetra-



FRAMING AND DETAILS OF WALLS, DOORS, WINDOWS AND FIRE STOPS ON STEAMSHIP PIERS

tion in mud where required. This was resorted to when hard spots were encountered. The jet pipe was sunk at the location of the pile, and, after removing, the pile was driven in the hole made by the jet.

The steel frame consists of transverse bents 50 ft. center to center resting on four columns. Four lines of longitudinal lattice trusses were used as bracing as well as to support two intermediate transverse trusses, the trusses being spaced throughout 16 ft. 8 in. to center. The side columns are constructed of a plate and four angles, the interior columns of two channels and I-beam. All truss members are constructed of two angles and purlins of I-beams and channels.

It will be noted that the floor of the warehouse is 9 ft. above mean low water, normal high tide being 3 ft. There are frequent tides 5 ft. above to 1 ft. below mean low water, giving a range of 6 ft., maximum conditions being somewhat greater. To reach the decks of vessels at various stages of the water and loading, hinged ramp bridges, constructed of steel with wood floors, are provided. These bridges are 27 ft. long and 13 ft. wide, set on a hinge 20 ft. inside the building and having a movement up or down of 20° (9 ft.) from the level position. The bridges are supported by heavy chains, being hung from an overhead gallows frame set 18 ft. from the hinge end. Counterweights are used to assist in lifting the bridges and the movement is controlled by chain and worm gearing. The bridge has a capacity of 10,000 lb. either concentrated on a small 4-wheel truck or distributed.

An endless sprocket chain sliding on the surface of the bridge in a steel trough, with teeth 6 in. above the floor level, is electrically driven through transmission shaft and sprocket wheel set at the hinge end, and pulls trucks from a low level into the warehouse, from warehouse up into a boat, or holds back a load going in the opposite direction. This chain is driven by a 20-hp. reversible motor operating at 220 volts d.c. and has a variable speed to accommodate any class of material being loaded or unloaded. The teeth on the chain engage the axle of a truck, and a load of 4000 lb. may be handled at a speed of 125 ft. per min. At 250 ft. per min. four individual loads of 1000 lb., and at 400 ft. per min. eight individual loads of 500 lb. may be handled, the total load at all speeds amounting to 4000 lb. The chain is located 4½ ft. from the edge of the ramp bridge, and will permit an empty truck to pass in one direction while the load is moving in the opposite direction.

Forty-six bridges are provided on the two warehouses, 34 being equipped with elevators, and the spacing has been made to fit the doors in any vessels operated by the different steamship companies discharging at the space assigned.

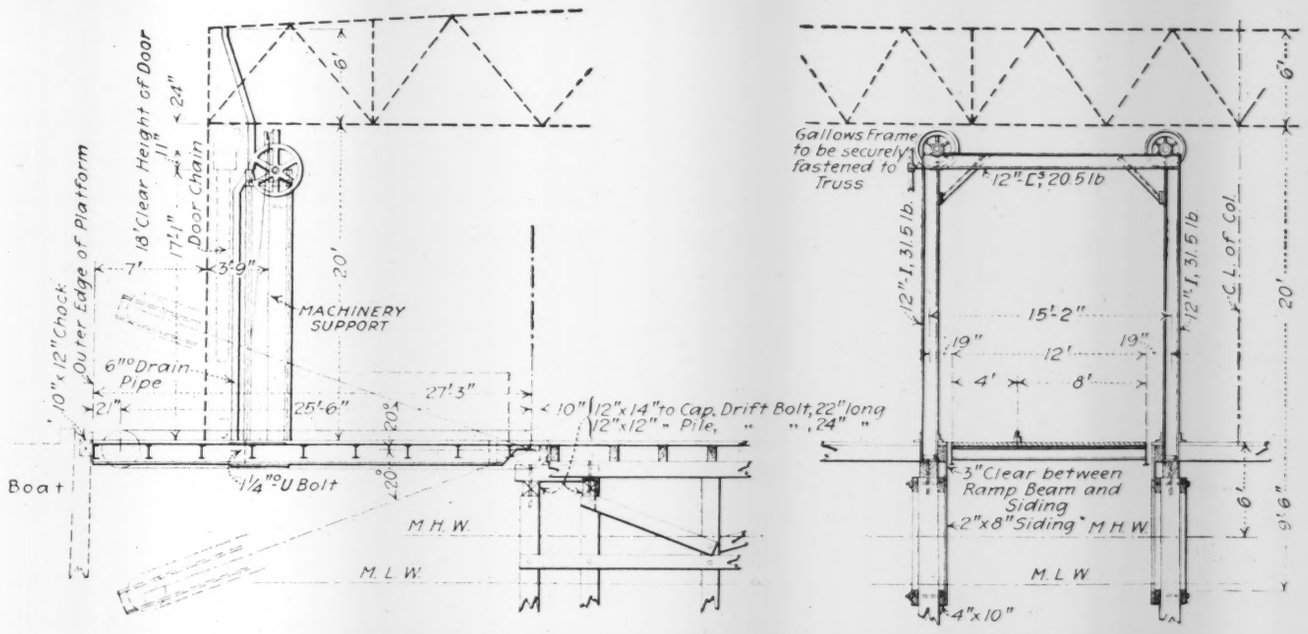
At about 300-ft. intervals the two buildings have concrete floor slabs 9 ft. wide resting upon pile bents and extending from side to side. Precast reinforced-concrete fire walls 4 in. thick, 10 to 13 ft. long, are hung from this concrete panel and extend 1.5 ft. below low water. Corrugated-steel fire curtains extending from the roof sheathing to the bottom of the steel trusses are placed on trusses at 150-ft. intervals. These curtains fit closely and are securely fastened to truss members by rivets and straps, forming an effective firebreak. In one of the views such a curtain is shown and the details of construction are given in a drawing.

The warehouses are equipped with an automatic dry-pipe sprinkler system to meet the underwriters' requirements. In each of the 14 fire areas two dry valves are located, one on either side of the building. From these dry valves the sprinkler pipes radiate, the total number of sprinkler heads being 5158. Hose valves are provided on each dry valve, and each one is equipped with 75 ft. of 1½ in. linen hose, nozzle and rack. Alarm gongs are also placed outside the buildings, one to each dry valve.

Water-supply is furnished from a 100,000-gal. steel tank, the bottom of which is 90 ft. above the ground. Emergency water-supply will be furnished from an intake in the edge of the river and will be forced into the mains by two 750-gal. per min. underwriters' centrifugal pumps, each driven by a 100-hp. motor. The piping system is so arranged that the water may be pumped into the tank or direct to the mains.

The first construction work undertaken was the bulk-

MOST OF PILES DRIVEN AND INTERIOR BULKHEAD IN MIDDLE FILLED WITH DREDGED MATERIAL



FREIGHT IS HANDLED BETWEEN BOATS AND WAREHOUSE OVER MOVABLE RAMP GANGWAYS

heads along the head of the slips and piers and along the south side of Lamberts Creek channel in order to prepare space for pumping dredged material. Piledriving began in April, 1916, and by the first of June sufficient bulkhead had been completed to permit dredging to begin.

In general, all equipment was floating, and at times six piledrivers were in use on the bulkhead work. Two large drivers were constructed for driving piles in the interior of the pier substructure, each being erected on turntable machinery in order to cover a wide area as they advanced. These machines were moved on rollers resting on platforms supported by the permanent piles, on which temporary caps were placed. Each of these machines was equipped with a Vulcan No. 1 steam hammer, the plunger of which weighed 5000 lb. All the interior piles were driven by these two machines, the lengths varying from 60 to 95 ft.

Interior bulkhead piles and those between the bulkhead and the edge of the piers were generally driven with floating equipment, this work being done after the dredging along the edge of the pier had been completed. A total of nine piledrivers were used on the work, including two small sheet-piledrivers. A large force of piledrivermen, blacksmiths, carpenters, laborers and dredgemen were employed, the total aggregating at times more than 250; 17,403 piles were driven in all structures, and the weekly progress report showed 500 to 700 piles for all machines at certain periods. All pile work was completed Mar. 15, 1917. Floating barges, with compressed air for boring machines, were used to aid the carpenters who did the framing.

The steel cylinders, which encased the bearing piles supporting concrete pedestals, were set by a small derrick barge after first dredging a hole. Piles were next driven inside and cut off one foot below the top of the cylinder, after which the cylinder was filled with earth and the concrete pedestal placed, using metal forms. The concrete was mixed by a machine mixer working on a floating barge.

Dredging of slips and the area between the piers and the main river channel was done by a large suction dredge, capable of cutting 16 ft. deep and 150 ft. wide as it advanced, and having a rated capacity of 10,000 cu.yd. per day of 24 hours under favorable conditions. A 22-in. pipe line was used to convey the dredged material to areas back of the bulkhead. At times this pipe line was more than 4000 ft. long. It was supported on pontoons and trestles over the area covered by water. Dredging began at the main river channel, heading in straight toward the bulkhead line. It required two lifts to cut to the required depth.

In depositing dredged material it was required that the pipe line follow the bulkhead in order that the heavy material would be deposited immediately adjacent thereto, the light silty material being forced to the interior. The larger portion of the dredged material consisted of white sand and clay, and it immediately gave good resistance after depositing. The results of this method reduced the pressure against the bulkhead and no failures resulted. Spillways were provided in the bulkhead, at the extreme end of the area to be reclaimed, for water to return to the channel. Dredging began June 1, 1916, and was completed Nov. 23, 1916, the total amount of material dredged being 1,373,226 cu.yd., an average of 8000 yd. per day.

All concrete pedestals and substructure of the 800-ft. pier were ready for the erection of the steel superstructure in January, 1917. The two outside tracks were laid on each pier, and on these a locomotive crane operated in setting the columns and longitudinal lattice trusses. This was followed by placing the side transverse trusses, purlins and bracing. After the two sides had been completed the center trusses were filled in, beginning at the outboard end and working toward the shore. The side transverse and longitudinal trusses, 61 ft. and 50 ft. long respectively, were shop riveted complete. The center longitudinal trusses, being 15 ft. deep, were assembled and riveted at the pier site. The center transverse trusses, 85 ft. long

and 9 ft. deep, were shipped in two pieces and riveted at the splice before erecting. The first steelwork was erected on Jan. 5 and the entire framework was completed Mar. 19 and riveted Apr. 21. The placing of the corrugated siding, fire curtains and painting followed later. The steelwork of the two buildings was 5,167,000 lb., erected in 62 working days.

Following the riveting of the steel frame the steel sash were set, then the roof sheathing, roof, flooring, and steel rolling-lift doors were placed in the order named. The freight-handling equipment and sprinkler system were installed at the same time.

It will be noted that each pier contains four tracks. On the area northeast of the warehouses, part of which was reclaimed by filling, a storage and classification yard has been constructed to serve the piers. A main running track, classification and storage tracks have been provided to meet the requirements of each building. These tracks have a capacity of 45 to 50 cars each. At present not more than three-fourths of the entire layout will be constructed, the remainder to be added as it is needed.

The quantities and cost of the development follow:

Dredging—1,373,226 yd		$108,922	$0.0794 per cu. yd.
Bulkhead A—775 ft. long		37,565	$48.50 per ft.
Bulkhead C—8,300 ft. long		138,291	16.70 per ft.
Main Pier Substructure:			
Bulkhead B, 3,320 ft. long	$65,355		19.70 per ft.
Pile and timber work	577,675		
Steel cylinders, 700,800 lb.	23,000		
Floor	34,825		
Total substructure	$700,855	$700,855	1.60 per sq.ft. pier area
Steel frame, curtain, siding, etc., 5,258,425 lb.	202,481		51.2c. per sq.ft.
Sheathing, painting, roofing, steel sash doors	167,250		
Total building	$369,731	$369,731	93.5c. per sq.ft.
Sprinkler system, pump house and pipe laying		74,060	
Freight-handling equipment		126,600	
Electric equipment and lights		20,000	
Engineering		30,000	
Creosoted trestle		12,000	
Tracks		90,000	
Office building		47,500	
Stevedore house		3,000	
Paving, etc.		5,000	
Right of way and damages		10,000	
Incidentals		26,536	
		$1,800,000	

The entire work was designed and supervised by the engineering department of the Norfolk & Western Co., J. E. Crawford, chief engineer; F. P. Turner, bridge engineer; L. L. Kelly, assistant engineer; R. J. Palmer, resident engineer.

The following contractors participated in the construction of the piers: James Stewart Co., bulkheads and pier substructure; Atlas Dredging Co., dredging; Virginia Bridge and Iron Co., structural steel frame pier sheds; J. P. Pettyjohn & Co., roofing, windows, doors, office building and substation; the Automatic Sprinkler Co. of America, sprinkler system; Otis Elevator Co., conveyors; Norfolk & Western Ry. Co., electrical department, electric lighting and power.

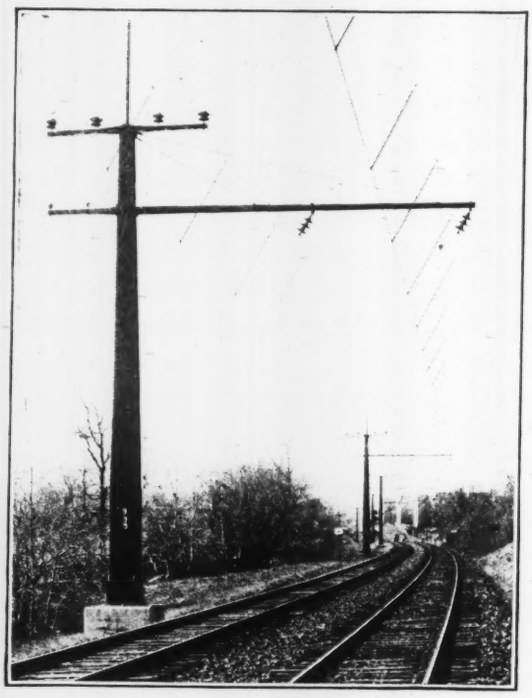
Impure Water Causes Infection

Water-supply investigations made recently by the New York State Sanitary Engineering Division, in connection with pronounced outbreaks of dysentery at Green Island, Seneca Falls, Newburgh, Washingtonville, Castleton, and Hoosick Falls, point to infection of the water. In each case recommendations for improvements in the supply or purification were made.

Pennsylvania Completes Electrification of Chestnut Hill Line

ELECTRIFICATION of the Chestnut Hill branch of the Pennsylvania Railroad, at Philadelphia, has been completed. This is an extension of the Philadelphia Paoli electrification, with which it connects at a point near West Philadelphia. It extends over the main line to North Philadelphia, and thence over the Chestnut Hill branch to Chestnut Hill. The length of the new electrified line is 10 miles, 2.3 miles of which is four-track, and 7.7 miles two-track.

In most respects the installation is similar to that of the Paoli electrification. The accompanying view



THIS HEAVY STRUCTURAL POLE USED WHERE SPACE WAS NOT AVAILABLE FOR GUYS

shows one of the structural poles carrying the overhead system. Ordinarily the tubular pole bracket-type construction was employed for this purpose, but at points where space would not permit the use of guys extra heavy tubular poles or structural poles, of the type shown, were used.

Gibbs & Hill, consulting electrical engineers for the Pennsylvania Railroad, handled the design and construction in the same manner as the Paoli installation.

Tunnel Between Denmark and Sweden Proposed

Tunnel connection of Denmark and Sweden has recently been proposed, with a view to carrying electric railway traffic across the strait. According to a note in the *Schweizerische Bauzeitung* of Mar. 2, the location selected extends from the island Amager, near Copenhagen, Denmark, to the island Saltholm and thence to Lunhamn, near Malmö, Sweden. The line is 22 miles long, including tunnel and surface portions. Its cost has been estimated at $25,000,000.

Two New Designs of Houses of Concrete Throughout

One Has Units Poured in Wire Cloth Forms with Air Space in Walls, Other Uses Cement Gun and Precast Beams

SHORTAGE of houses throughout the industrial and shipbuilding centers of the country has led to a number of suggested designs which will provide safe and comfortable homes at reasonable cost and which at the same time lend themselves to quantity construction. Among these are two of somewhat similar details, which are of concrete throughout. They have reinforced-concrete frames with double walls of stucco and plaster, all erected with a minimum use of forms or stages.

Two experimental houses now being built for the Pennsylvania Cement Co. at its mill at Bath, Penn., embody as a new idea in dwelling construction the utilization of sheathed wire cloth as the forms in which to pour the concrete units making up the house frame. The type of construction has been named the "Alcho System" and is being developed by Albert Oliver, of the Clinton Wire Cloth Co., New York.

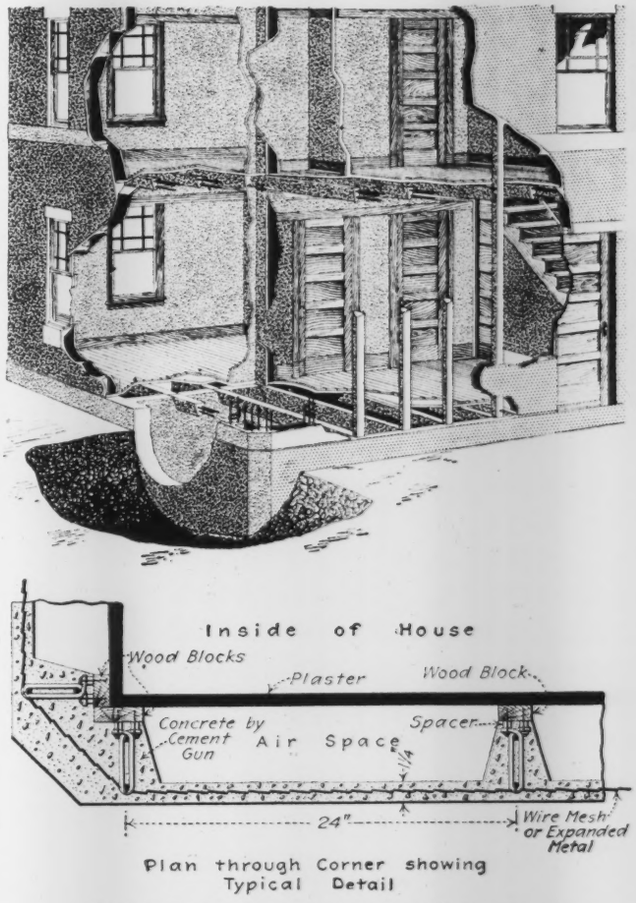
Fundamental in the design of the house are the studs, which are triangular in shape and of concrete reinforced as a column. On the inside of these studs is a plaster wall and on the outside a concrete stucco facing, leaving between an insulating air space. Each stud carries a floor-beam of similar triangular design, and integral with these floor-beams is a reinforced-concrete floor or roof.

The studs are erected on cellar or basement concrete walls poured in place, using as stud forms continuous sheets of Clinton welded sheathing, which is a building paper woven into a wire cloth. This is bent to shape the studs, and the concrete is poured inside. Outside the sheathing are rows of furring rods which protrude beyond the apex of the stud triangle and to which are fastened the sheathing, making the inside form for the outer wall. This leaves a small air space at each stud to prevent precolation through the wall there. The base of the stud also has sheathing against which the inner wall is plastered.

Beams are varied in depth according to the span required. They, too, are cast inside sheathing for forms, the sheathing being supported on struts during construction. Hangers left in the beams carry furring on which the ceiling is plastered. The floor itself is poured to be integral with the beams, and can be finished as desired. Wood frame doors and windows are detailed as shown in the drawings. Stairs are of concrete, and partitions of concrete or plaster applied on wire cloth. The roofing will be fire-resistent material on the concrete slab where flat and probably on timber-framing where sloping.

It is intended that the Bath houses shall be of poured concrete, with hand plastered walls and partitions. Provision is made, however, for the use of the cement gun in placing concrete, in which case the studs are turned with the base of the triangle outward to facilitate placing.

In a type of house devised by John V. Schaeffer, president of the Cement Gun Construction Co., Chicago, it is intended that the studs and walls shall be built entirely by the cement gun, while the beams are precast concrete and the floors are poured in the usual manner.



IN THIS TYPE THE CEMENT GUN IS USED

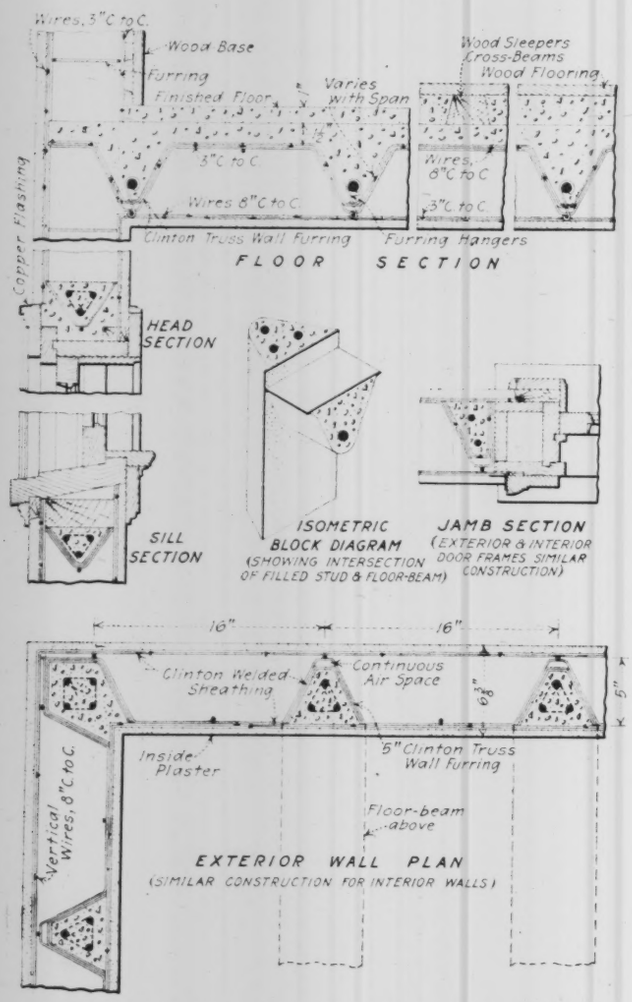
In the accompanying sketch is shown a broken corner of a proposed house of the cement-gun type with all elements of construction in view, and a horizontal section through the wall showing the details of the characteristic design. This wall structure comprises studs on 34-in. centers integral with a 1½-in. outer wall and separated from the inside plaster wall by wood blocks fastened to the studs and the wall, leaving an interior air cell for insulation against temperature and moisture.

In building the house a cellar is first excavated and cellar walls are built in the usual manner, except that recesses are left in which are set the precast joists for the first floor, spaced 24 in. on centers to match the studs. On this frame as a platform subsequent construction is carried on. A temporary timber framework is then erected on the platform and the wood blocks of the studs, to which has already been attached the reinforcement as shown in the floor section herewith, are set up.

After the wall reinforcing fabric is placed the walls and studs are shot with concrete from cement guns. When the upper floor is reached, precast beams are placed with protruding reinforcement intertwined with the reinforcement of the studs and the connection is made with the cement gun. Plastering, on wire mesh, is then placed on the inside wall and belt courses are

shot around the tops of the studs so that all air spaces are isolated at each floor, and after the plastering is in place each air space or cell is a unit. This is designed to prevent circulation of air or migration of vermin.

Various methods are proposed for the backing against which the cement-gun concrete is forced, including the use of separate unit forms which can be used over and



CONCRETE STUDS AND BEAMS POURED INSIDE SHEATHED WIRE CLOTH FORM FRAME

over and sheathed wire fabric. In the latter case the fabric, being inside the wall, can be left in place.

In so far as the house itself is concerned, details of layout and architectural treatment can be provided to suit conditions in either of these designs. It is stated that estimates of cost submitted by reliable contractors are higher than for plain-work construction, but compare favorably with the cost of the cheaper type of brick house with wood floors. The method is cheaper than most fire-resisting construction.

County, Lacking Labor, Will Use Prisoners

The county commissioners of Clark County, Ohio, of which Springfield is the county seat, have determined to use prisoners who may be in the local jails as laborers for road work during the current spring and summer. So short is the local labor supply that it is felt that otherwise this work could not be carried on. Motor trucks will be used for transportation.

Military Road Building Difficult Even in America

Experience Last Winter Shows Maintenance To Be Principal Item—New Type of Permanent Highway Recommended

By Capt. Frank W. Harris, U. S. A.
Consulting Engineer, Pacific Coast Defence League

THE long, unending lines of overloaded army trucks grinding through the surfaces of average roads "Somewhere in America" stimulate the thoughts of all whose duty it is to keep the wheels moving in war time, and force home the conclusion that their task is almost impossible, a job for a veritable Hercules. However, as the motto of the corps is *Essayons*, we press on, determined that no lack of organization, no shallow study of the problem, no slip on our part, shall cause failure. With this thought in mind and with last winter's experiences as a basis, conclusions as to the character of work required, and recommendations as to organization, methods and materials, are given.

The conditions governing troops on road construction and maintenance bear a certain analogy to those of similar work in civil life, but the differences are far greater than would be supposed. It has been demonstrated that the efficiency of the troops in highway labor is directly proportional to their military training and discipline. In close-order drill the men unconsciously obey their officers, and this obedience is easily transferred to the work. Therefore, it is important that a proper amount of drill, at least two afternoons a week, should be insisted upon, even though the amount of work ahead should be a temptation to dispense with the drill. The extra efficiency produced thereby, will far outweigh any temporary advantage gained in work accomplished while the men should be drilling.

The result of overwork and under drill soon shows itself, not only in the smaller amount of work performed per man, but in their appearance, the condition of the barracks and their general conduct, all of which bear witness to a falling off in morale. Discipline and control once lost are extremely hard to regain and should be kept firm at all costs.

There is another feature of the organization of a road-building company quite different from conditions on civil work. This is due to the great variety of men supplied. On one particular job in mind, we had two battalions of forestry engineers, one replacement regiment of pioneers, and one regiment of highway engineers. Also at various times companies of railway engineers were connected with the work, and all these several classes had to be organized into an efficient road-building machine. Add to this the fact, that due to the conditions which govern recruiting, some whole companies contained only men trained to the highest degree in the most finished methods of street work, and the difficulty of organizing can be readily seen. It is estimated, where men work in squads, that about one man in eight should be a specialist, and that the rating of a company should be 20% of men with directing ability, and the remainder men with the necessary physique for carrying on the laborious work connected with road building.

It will be seen from the above that the greatest problem of organization is the selecting and assigning of the noncommissioned officers. The qualifications to be considered and the reasons therefor are briefly summed up in the following: Those used to handling men give good results, and for this reason general experience in civil life should be carefully considered. On military roads the work is generally rough, and a man who is able to utilize anything at hand is preferable. This qualification is more generally found in men who have had experience in places far away from the trade centers, and who have had to depend upon pack trains or other irregular means to supply their needs. They should also be men able to assume a military bearing, and give clear, specific commands, for there is nothing which will upset a company more than the habit which some officers have of looking at a squad and saying, "Three of you men come here." Immediately the entire gang stops work, the men look at one another to see who is going, and the result is lost time. No matter how small the task, the man to perform it should be called by name.

Care of Men and Livestock

In this connection, a word in regard to the treatment of the men and their care of livestock is in order. The question of shifts has a direct bearing upon the amount of work done. The writer found that the best work was done where one company worked in the morning and another in the afternoon, and in the summer time two six-hour shifts should give good results. When men are worked all day, every effort should be made to serve a hot dinner. This more than pays for the effort. When working on six-hour shifts, a light lunch should be provided in the middle of the shift, to save two hours.

In the same way the care of stock should be carefully watched. The mule is a deliberate eater, and should have plenty of time. The tendency to work stock all day without eating is disastrous, and I have seen 60% of the mules in one camp knocked out by improper care. It is found also that the army forage ration is not sufficient to keep the animals in good condition when working hard, and they must be fed more by skimping the sick, and the well animals which are not working.

The organization having been completed, the criterion of its efficiency and discipline is the average number of men available for actual work. A good average for a company of 250 men would be 180 men on the job, which average is dependent upon the number on special details. This matter of details can be abused, and thoughtless requests for men can almost bankrupt an organization. It is a delusion held by many, including the men themselves, that soldier labor is cheap and inexhaustible. However, the cost consists of more than the $30 per month which they receive; it must be remembered that each soldier in America costs the Government about $4 per day and each soldier in France probably $6 per day. Using men to perform trivial tasks by primitive and time-killing methods is therefore reprehensible.

The work of this organization is to build new roads and maintain them and the existing highways on all kinds of soil foundations. The soil under the roads built last winter was soft clay and gave a very poor foundation. The construction used was macadam. In conversation with an engineer who had spent 19 months upon the western front, I found that this condition is typical, and that practically all the roads are macadam. At times, however, asphalt is used to finish and repair existing roads.

The winter's experience has demonstrated that by far the greater amount of the work is maintenance, and the problem is not so much which kind of a top should be put on as which kind of base would it be possible to put in. The striking feature of military transportation is the unending stream of trucks which destroys the surface, and this not only requires a solid base to support the heavy concentrations, but also demands that the highway engineer, like the railroad engineer, must maintain his roadbed without disturbing traffic.

In the selection of the equipment for the road-building company, the main consideration is simplicity. The army transport system is like a pack train, and the engineer will always be out of something; therefore all plants should have parts easy to repair or replace. The confusion in all kinds of stores is incredible, and there is no royal road to order. The motor trucks used in maintenance should be of high power, on account of the poor roads. In our work the 5-ton chain-drive trucks gave good results. The 3-ton trucks were faster on good roads, but did not stand the hard usage so well. The two chief reliances of the road engineer will prove to be the stone crusher and the road drag—the first to produce material to fill chuck holes and ruts, the other to conceal the ruts so that the truck drivers will not be able to follow in one track.

Drainage and Subgrades

As in all highway work, drainage is of prime importance in military-road construction. Unfortunately, the tendency is to secure the shortest distance, irrespective of the grades and foundation. Where new location is to be made, grades of not less than 1% in the ditches should be obtained if possible, and the engineer can afford to sacrifice one mile in ten of distance to get good drainage and subgrade. Where roads are already located, the worst trouble comes from water-filled chuck holes, and these must be eliminated at once. In swampy country time will generally be saved by the use of corduroy in the first instance, as eventually it will have to be resorted to anyway.

These incomplete notes show the desirability of permanent military roads in our country. They should be built of concrete or its equal, and for heavy traffic should be 40 ft. wide, and divided into three sections by two curbs, 6 in. high and 8 in. wide, one on each quarter. The concrete should be 8 in. thick under the 20-ft. central drive, while 5 in. will be sufficient on the 10-ft. shoulders. These curbs are important, as they divide the heavy traffic from the light, and save military police. For the lighter traffic roads no curbs need be used, and a width of 24 ft. and a uniform thickness of 8 in. will be sufficient.

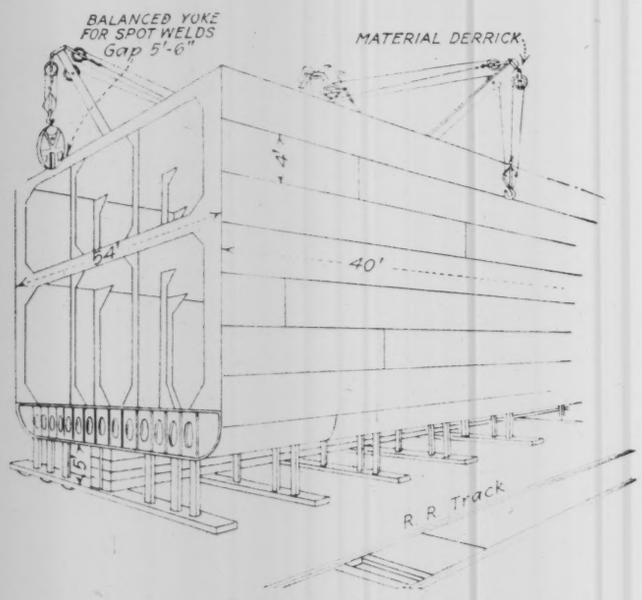
No man can see the end of this war, and the defense of our homes is our plain, simple duty. We cannot all go to France, but those living here can "do their bit" by making our coasts as safe as possible.

Electric Welding for Ships Under Test on Large Scale

Kearny Shipyard Will Assemble Section of Ship By Spot and Arc Welding, for Strength Test by Fleet Corporation

CONNECTING the plates and the frames of a ship's hull by electric welding, instead of by riveting, is about to be studied in tests upon a 40-ft. length of a 9600-ton cargo steamship, at the shipyard of the Federal Shipbuilding Co., Kearny, N. J. The Emergency Fleet Corporation is making the test; the details are being directed by Arthur J. Mason for the corporation. Of the hull section now being built for the purpose, shown by the accompanying sketch, about one-fourth will be connected by rivets and the remainder will be weld-connected. The completed hull section is to be filled with water—a weight of 2500 tons—and is to be subjected to strain by shifting its supports. Various forms of abuse, as striking it with rams, will also be tried.

Both spot welding and continuous arc welding are to be used, the former for connecting the frames



SHIP SECTION BEING BUILT FOR WELDING TEST

and plates during erection and the latter for joining the seams. Strength tests of spot-welded pieces of steel plate have already been made, and unofficial reports are to the effect that excellent results were obtained in both static and endurance tests.

In a recent report to Charles Piez, vice-president of the Emergency Fleet Corporation, Mr. Mason makes it clear that the first gain to be expected from replacing ship riveting by welding is in labor and time, but that on further development a large saving in weight of hull, up to 10%, may be realized. The report says:

"It has been necessary to design a ship to suit the material available, without encroaching on that needed for the regular ship construction at the plant. This has been done. The hull will have the outline, dimensions and strength conforming to the ships the Federal Co. is building. It has been thought best to conduct the work at a site apart from the shipways, so as not to interfere with that program.

"A 10,000-ton ship, costing $2,000,000, now costs but $70,000 to rivet. It must be plain that if electric welding only promises to modify this amount no very substantial gain offers. Splendid benefits we all feel do offer themselves in the possible change in the whole regime of shipbuilding. Our test has in view abolishing or greatly diminishing (1) the railroad journey from rolling mill to fabricating plant, when the latter is not at the shipyard (2) the template makers' work (3) the markers' work (4) the punching (5) much of the work of the fitters and bolters who flog and pull the pieces to fit on the ways. There lies in the above items an excellent likelihood to save a month's time in construction and a saving of no less than $40 a ton in the cost of steel structure.

"Briefly, the program is to assemble a hull rapidly by spot welding, tacking the ship together much as a tailor bastes his work in assembling a suit of clothes. The structure then becomes a house favorable for such work in all weather and at night in which the completion of the ship may go on. After the material is thus assembled and fastened with spot welds, so that it is sufficiently strong to hold its shape, the work is completed by arc welding all seams to insure strength and render the work watertight. Roughly, we expect the spot welds to be about 10 in. apart.

"The preparation of the site is well under way; the piledriving will be completed within ten days. The severe tests of strength contemplated needed about 300 piles. One-quarter of the structure will be riveted, the other three-fourths welded, so that the tests of strength will afford a basis of comparison.

"Electric welding offers a great field for lightening a ship. In this design various views of this opportunity will be tried out. The field here is very great—ultimately 10% of the steel may be eliminated.

"If one visits the ways at any shipyard it becomes obvious that at any instant only a modicum of the men are for the moment at work. This is unavoidable under the present system. We hope to establish a plan of assembling with more continuity and less waiting on one another. Only a fifth of the men on a hull are riveters. The spot-weld yoke will forthwith pull the parts to place with a much more vigorous agency than flogging and pulling to place by numerous bolts, now done by the other four-fifths.

"The problems of fitting in place the parts of a hull are almost wholly problems arising out of the necessity to make a number of little holes in a plate, made by one man at one time and place, fit a number of little holes made by another man at another time and another place. Once all holes are left out of the material, all parts fit. The creeping and kindred problems so perplexing to the shipbuilder disappear. Every plate becomes a closer. Every plate justifies itself.

"The manufacture of the spot-welding yoke and appliances is placed in the hands of the Universal Electric Welding Co. of Long Island City. The early stages of the arc welding are to be accomplished by the Wilson Electric Co., which was so successful in the work on the German ships' repairs, but it is the intention to call in all men with ideas and apparatus."

Conflagration Stopped by Fire-Resistant Buildings

Concrete Warehouses in Path of Flames Hardly Harmed by Fierce Fire in Kansas City Wholesale District

A FIRE-RESISTING construction served to stop the progress of a serious conflagration in the wholesale district of Kansas City, Mo., on Apr. 4, and saved most of the contents and structure of the buildings so protected. The fire started in the upper floors of a furniture warehouse on the southwest corner of Santa Fe St. and St. Louis Ave., and before it was stopped had burned the equivalent of practically two city blocks, consisting of warehouses and manufacturing buildings.

The intensity of the fire is evidenced by the fact that railroad buildings and other wooden structures three blocks west and two blocks south were seriously menaced and were saved only with the greatest difficulty and by extended effort on the part of the fire department and railroad forces, and with the use of all available fire fighting equipment. Firebrands were carried by a strong northeast wind toward these buildings, and large forces of men were used in extinguishing them and throwing them from buildings for several blocks south and west of the fire.

The structures destroyed were mostly five-story and six-story warehouses used for storage and sample rooms for various out of town implement dealers, wholesale grocery houses and other industries. They were in nearly every case built with brick walls, timber floors, plain glass windows and tar and gravel roofs, and were situated without spaces between them except where streets and alleys intervened.

The two most remarkable features of the fire were first, that it jumped across the Missouri Pacific Ry. tracks a distance of 100 ft. almost against the wind; and, second, the remarkable lack of damage to three reinforced-concrete buildings, two of them in the direct path of the flames

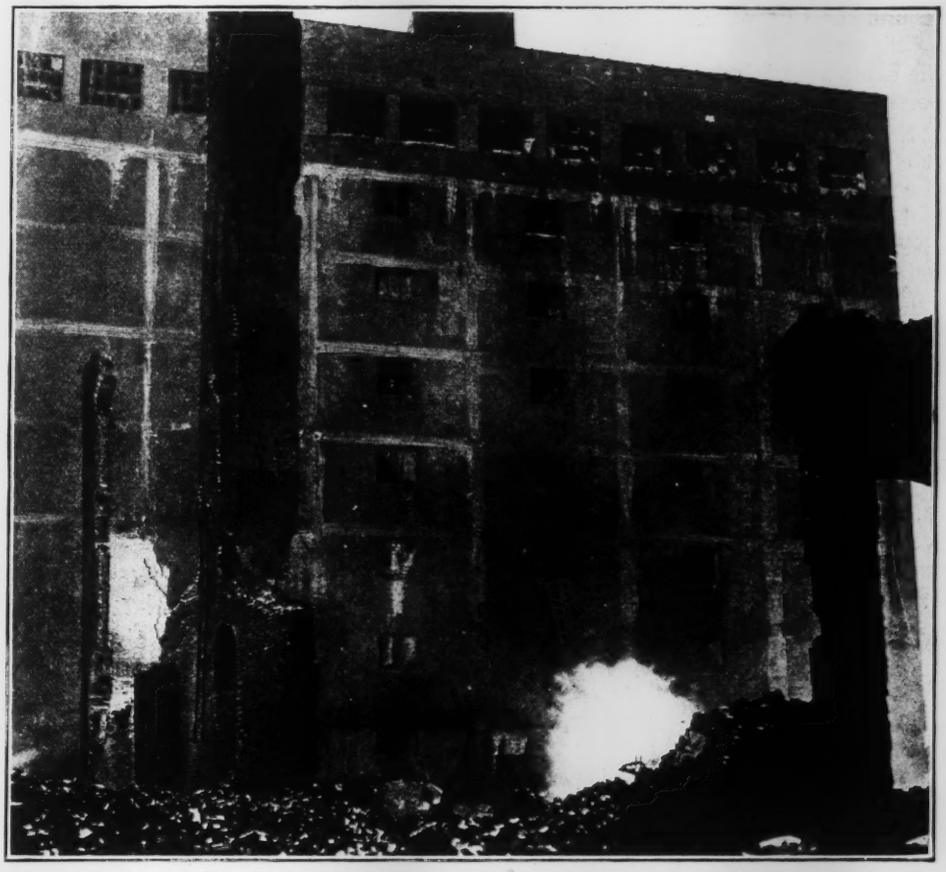
The Ridenour-Baker building, separated by only a 22-ft. alley from the building within which the fire started, was of reinforced-concrete floors, beams, and columns, with brick curtain walls and wire-glass windows. The wire glass in the windows was nearly all destroyed by the flames, which were driven by a strong wind toward the east side of the building, but on the south side only a few of these windows were destroyed.

The accompanying picture shows a view of the east side of the building with the wire-glass hanging from the upper windows. The stock of groceries was seriously damaged by fire and by water from the sprinkler system.

The next building to the west, owned by the same parties, was built entirely of reinforced concrete and with stood the ravages of the flames without damage of any consequence. The wire-glass windows were everywhere intact. The roof of this building was badly damaged by the fire, but without injury to the building or its contents.

The Brokers' Warehouse & Storage building, 60 ft. east of the block in which the fire started, is of the same general construction as the Ridenour-Baker building, next to the fire, except that the former structure had wooden window frames and the windows were of plain glass. The window sash were badly burned, and when the windows broke the sprinkler system opened up and water damaged stock in storage and contents of offices on the west side of the building.

The origin of the fire is still unknown, and investigations are being made by various authorities; but when the fire started, 5:40 p.m., the streets were full of employees, and for that reason it could not reasonably be inferred that it was of incendiary origin. The fact that the fire started in the floor of a warehouse full of combustible oils, varnishes and furniture, seems to offer considerable argument for the theory of spontaneous combustion or accidental origin. The total property loss is now estimated at $2,000,000.



BUILDING HAS CONCRETE FRAME AND BRICK WALLS WITH WIRE GLASS WINDOWS—IT STOPPED THE FIRE

Coarse Sand Proves Superior for Vitrified Brick Grout

On Two Jobs, Where Contractor, Engineer, Foremen, Inspectors, Labor, Brick and Cement Were Same, Value Was Apparent

By Job R. Rogers
New York Commission of Highways, Hoiley, N. Y.

CONSIDERABLE differences of opinion as to the relative values of sands used in cement grout for vitrified brick pavement have always existed and will no doubt linger in certain places where there is a choice and where actual experience has not patently demonstrated a difference between different grades and varying coarsenesses. Frequently, no doubt, an inferior sand is used because of the superficial cheapness of a local deposit, but an experience of the writer served to convince him that such initial differences should not be considered, since the item itself is small in comparison to the cost of the finished pavement, and anything but a first-class concrete sand is not satisfactory for grout under even the lightest traffic.

During the summer of 1914 the same contractor built two brick highways for the State of New York in Orleans county. One, the Albion-Fancher state highway, is approximately a mile long and 16 ft. wide: the other, the Holley-Brockport state highway, Part 1, approximately 1.7 miles of 20 ft. pavement. On both contracts the same cement was used, the work was done by the same gang, under the same foreman, and with the same inspectors, but not the same engineer, although the engineer on the second of the two contracts helped on the first. Furthermore, the brick were from the same manufacturer and the grout of the same proportions and mixed in the same type of machine.

However, the sands used were different, since the two jobs were about eight miles apart. On the first road the sand was fine, sharp and gray, having the mechanical analysis and physical properties indicated by the following table:

Mechanical Analysis		Compressive Strength, 3 In. Cubes, Lbs. per Sq.In. at the Age of 14 Days		
Sieve Opening	Per Cent. Passing	Ottawa Sand	Sand as Mined	Sand Washed
¼-in.	100 0	1,470	1,115	920
6 mesh	99 6	1,570	1,010	900
20 mesh	87 5			
50 mesh	39 4	Av. 1,520	1,062	910
100 mesh	6 0			
200 mesh	2 4	Voids, 36%. Loam, 5.2%. Reported by laboratory as too fine for concrete, but later accepted for grout.		

The sand used on the second road was a coarse, sharp sand—so coarse that it seemed doubtful whether the grout made from it would fill the joints properly. Its analysis was as follows:

Mechanical Analysis		Compressive Strength, 3 In. Cubes, Lbs. per Sq.In. at the Age of 14 Days		
Sieve Opening	Per Cent. Passing	Ottawa Sand	Sand as Mined	Sand Washed
¼ in.	97 2	1,470	2,450	1,470
6 mesh	90 7	1,570	2,070	1,630
20 mesh	28 2			
50 mesh	6 2	Av. 1,520	2,260	1,550
100 mesh	3 0			
200 mesh	2 0	Voids, 30.4%. Loam, 4.8%. Accepted for all classes of concrete.		

A comparison of the two reports indicates that the sands possess, (1) vastly different degrees of coarseness, (2) some difference of voids and, (3) only a negligible difference in loam content. But notwithstanding the rather extreme coarseness of the second sand, the penetration of grout made from it was perfect, as was later demonstrated when a section was removed during the construction of a telephone conduit.

In the one mile strip on the first road, where the fine sand grout was used, there is a considerable area from which the surface grout has been removed by traffic or other causes. These areas occur in small patches and occasional strips 2 to 3 ft. wide and about 10 ft. long. These places have been repaired with asphalt. So far inspection has been unable to detect any such places on the other road where grout made with the coarse sand was used.

The conditions of construction were ideal for a comparison. The use of the mixer gave an evenly mixed grout which was quickly swept into the joints, allowing no opportunity for segregation of the sand and cement.

In each case a local pit sand was used. In the one case a first-class concrete sand was obtained, while in the other the fine sand was rejected for concrete but accepted for grout on the theory that a finer sand is needed for grout than for concrete.

The same fine sand was used in the grout on the Albion village state highway No. 5448 by another contractor with identical results. The lesson to be learned from this experience would seem to be that no matter how great the saving—which may be considerable in itself but small as compared with the total contract—none but the very best concrete sand should be used for grout even though necessary to import it from a distance Also, other requirements being met, the coarser the sand the better, as the writer has yet to find a real sand too coarse to enter the joints.

High Pressure in Tunnel Construction

A maximum pressure of 47 lb. per square inch has been reached in the construction of one of the four new tunnels under the East River connecting the boroughs of Brooklyn and Manhattan, New York City. The tunnel in which this high pressure was obtained is that between Sixtieth St., Manhattan, and Queens, and will be used for a subway line which will operate between the elevated lines in Queens and the Broadway subway in Manhattan.

The pressure of 47 lb. is the highest ever encountered in compressed-air tunnel work, with a single exception. A pressure of 52 lb. was once reached for a very short time in the construction of a gas main tunnel under the East River. However, such a pressure would not be used today, as it is forbidden by law.

When the 47-lb. pressure was reached in the subway tunnel, workmen could remain under it only a very short time. The work was done in shifts of 45 min. each, and only two of these working periods were allowed in each 24 hours. The great presssure was necessary because of the depth at which the tunnel is being dug, more than 100 ft. below the river surface. This low point was necessary on account of the depth of the west channel of the East River between Blackwell's Island and Manhattan. In order to cross this channel it was necessary for the Public Service Commission to obtain the permission of the United States Government to place a false bottom under the west channel. This was done by depositing more than 60,000 cu.yd. of clay and riprap.

Road Builders at Work Close to Front of American Sector in France

Maintenance, Reconstruction and Quarrying Proceed Despite Interruptions by German Shelling—Our Engineers Have Installed a Mechanically Operated Quarry, First of Its Kind on Any Front in France

By Robert K. Tomlin, Jr.
War Correspondent of Engineering News-Record

IN TWO previous articles dealing with the work of the road service of the American Expeditionary Forces here in France my reports of progress were necessarily confined to matters of organization, inspection and planning. These were the early days back in January, when the principal activities of the chief of the road service and his department heads took the form of investigation and report. The results of our efforts were then on paper, not on the ground, for the rank and file of our special road-building and quarry regiments were still at Camp Meade in Maryland, and practically no construction plant or tools had been received. Since those days a big change has been wrought. The vanguard of our special road construction and quarry forces landed in France some time ago. Road service headquarters was immediately shifted from Paris to a point nearer the front. A limited amount of equipment was received, some of it from the states, some from local sources. Men who had been chafing at desk jobs were transferred to open country. District offices were established; construction gangs were detailed to selected areas; and the real work of road reconstruction and maintenance in the zone of American operations in France began.

The machinery of the organization up to this time had been in the assembly stage. Now, however, the throttle has been opened and the wheels are turning. We are not yet going at full speed, but we are moving along nicely, and each week sees the lever jacked forward a notch or two. American road builders are now at work on military highways and in quarries within the range of German artillery fire as well as in other areas between the front and our seaport bases.

HAND QUARRYING PENDING ARRIVAL OF CRUSHER

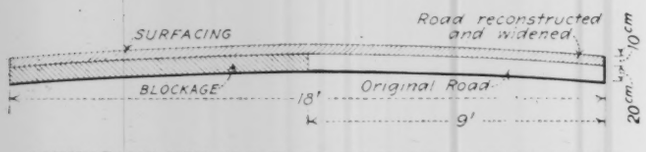
I have just come back from the advance section of our road service, where work, subject to interruption at any time by high explosive shelling or drenching by mustard gas, is being carried on under the direction of a captain of engineers who was formerly a division engineer in the New York State Highway Department. Upon his shoulders has fallen the responsibility of getting the job in the forward area started. His status, like that of several other engineer officers assigned to different areas of France, is that of a division highway engineer reporting directly to the chief of the road service, who is located at present at the general headquarters of the American Expeditionary Force.

Just a little more than a month ago—on Feb. 15, to be exact—road work up near the front was begun by American forces. Since then things have moved swiftly. About 1500 men are now engaged in road reconstruction, maintenance, and quarrying in this advance zone. They are operating in seven groups, each group being assigned to a territory with definite limits. Five quarries are being worked by our men. Mechanical equipment has begun to arrive. Several crusher installations have been set up, among them one with overhead bins and mechanical elevating equipment, said to be the first of its kind to be erected behind any front in France since the war started, almost four years ago. Four days after the machinery and wood for the bins arrived at the quarry site our men had this outfit producing crushed rock. Nor have we stopped at the innovation of the portable crusher plant with its elevating conveyors and storage bins. We are causing a good deal of comment among French engineers, I am told, by the use of bottom-dump wagons and elevating end-dump motor trucks. Such equipment as we are using for quarrying and transportating rock is a decided novelty over here, where the practice of depending on hand labor rather than mechanical plant is far more general than is the case in the United States.

As I stated in a former report, our road builders do not have to concern themselves to any great extent with the construction of new roads. There are already plenty of highways leading to the front, and our job now is maintenance, reconstruction and widening of existing waterbound macadam roads. Where our road and quarry regiments are operating near the front the amount of work to attend to is about one mile of road per square mile of land. Certain "national" highways leading toward our battery positions and trenches are already of ample width and possess good foundations and drainage. Ordinary maintenance work is all they

require. Some of the offshoot roads, however, are only from 9 to 12 ft. wide and these must be increased to from 18 to 25 ft. in order to carry artillery and motor truck traffic. These offshoot roads are in most cases too thin to stand the heavy traffic of war and our men are reconstructing them, as shown in the sketch.

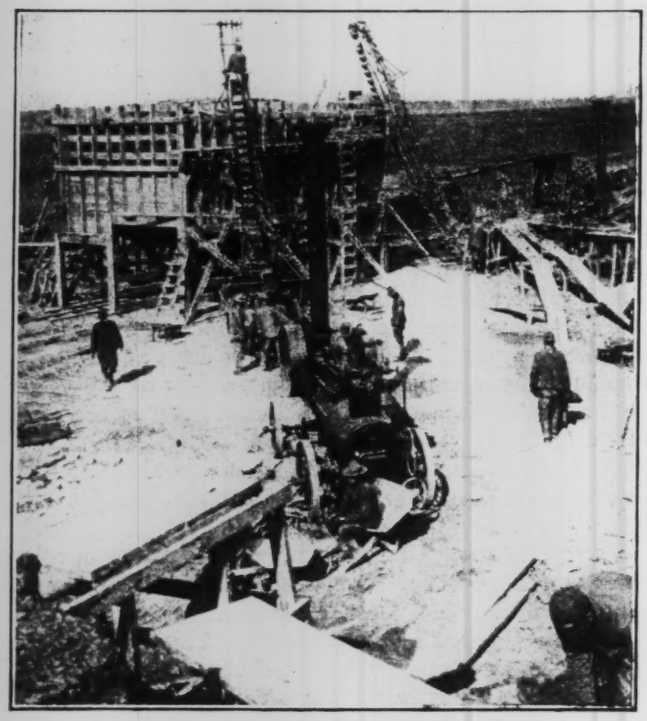
The reconstruction work involves the preparation of a subgrade, which is not rolled, and the laying of a foundation course of large stone or "blockage" to a thickness of 20 cm. This blockage is set by hand and chinked in with smaller stones. Then on top of it is spread a 10 cm. layer of crushed stone 1 to 4 in. in size,



AMERICANS USE OLD ROAD AS HALF BASE FOR NEW

this layer being extended across the surface of the existing road, which serves as a base for about half of the widened route. When a roller is available the top course is rolled down; otherwise the compacting must be done by the traffic itself

There is nothing very elaborate about the work. It is macadam road reconstruction reduced to its simplest form, for under the conditions that obtain in the advance section our engineers have found that this is the only type of road it is practicable to build and maintain. The captain of engineers in charge of our advance section work states the case thus: "The war-time type of road for France is the waterbound macadam road. It is the road for which local material is available and for which the methods of maintenance and reconstruction are simple. The fact that the local stone has a high cementing value is another argument in its favor." The stone referred to is a soft limestone, almost white.



AMERICAN ENGINEERS HAD THIS QUARRY IN OPERATION FOUR DAYS AFTER EQUIPMENT ARRIVED

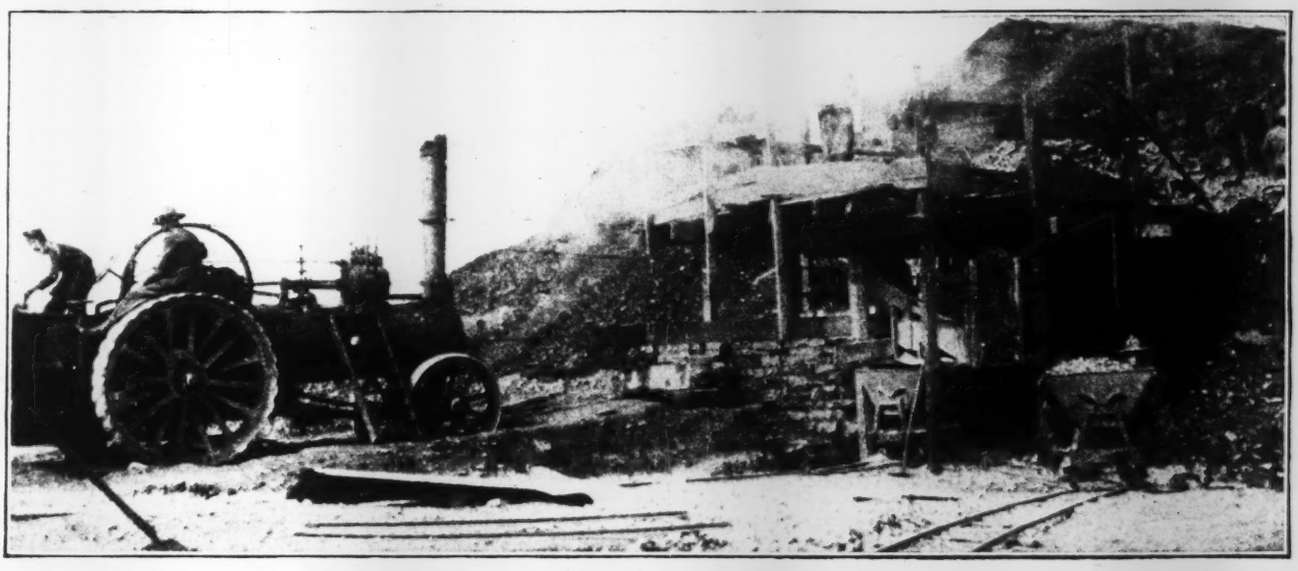
Our policy in road building is to use local material as far as possible, thus cutting down on the length of haul for crushed stone. This is very important, for with quarries located far from the job the motor trucks hauling crushed rock for maintenance and reconstruction destroy the very roads for which they are bringing up repair materials. Then, too, it is now, in the early spring, that the roads are subjected to their severest test, for at this time military activity generally increases after the winter's lull and the roads must be cleared, so far as possible, of all traffic which does not carry ammunition, supplies and the other essentials of combat and sustenance. Giving weight to all of these factors, our road service is opening up, or taking over from the French, many quarries, on the theory that many quarries mean short hauls for crushed rock, and consequently fewer trucks operating on the highways.

Up to within a short time ago most of our quarrying was a hand-labor job. Some of it still is, but our aim is to install mechanical equipment at all quarry sites just as soon as such equipment is to be had. *The accompanying photograph shows the first mechanically equipped quarry which American engineers have installed near the front.* It is of the semiportable type, with jaw crusher, overhead bins and elevating conveyors. This is the plant which was set up in four days. As previously noted, this layout is a decided departure from previous practice of the allied armies behind the front. The rock here is the prevailing soft limestone which, after being blasted—generally at night—is loaded into wheelbarrows and delivered by inclined runways to the jaw crushers.

The elevated bins, it will be noted, have two openings below. The larger of these is for motor trucks, while the other is for light railway (60 cm. gage) cars. American quarry practice over here is making a marked cut in the man-power required for operation by the provision of gravity loading of crushed rock into motor trucks, light railway cars and bottom-dump wagons.

Another of the views shows a gyratory crusher which had been set up only a couple of days before I took this picture. At the time overhead storage bins had not been erected at this site, which had previously been worked by the French.

In another photograph a detachment of our quarry regiment is shown breaking rock by hand, pending the arrival of a crusher. The captain in charge of this work had established his camp only a few days before my visit to this quarry, and, eager to increase his output of crushed stone, he was preparing to build a crusher of his own from odds and ends of metal which he had ferreted out in a junk shop in a near-by town. "As soon as I can get the authorization to spend a few hundred dollars for this stuff," he said, "I will have a crusher set up and running in a few days." This spirit is typical. Our men have had to proceed with their work in the face of difficulties of all sorts, shortage of men, shortage of plant, delays in railroad shipments, etc. Yet they are not sitting down and waiting for something to turn up. When mechanical plant does arrive it is set up in a jiffy; if it is delayed, some sort



THIS QUARRY, TAKEN OVER FROM FRENCH, IS SHOWN PARTLY EQUIPPED WITH GYRATORY CRUSHER, THE OVERHEAD STORAGE BINS NOT HAVING BEEN BEGUN

of makeshift is resorted to, or else the rock is barred out and broken by hand. From four of our quarries where mechanical plant of some type is in service we are turning out about 500 cu.m. of rock daily, and the work is as yet hardly organized.

Most of the transportation of crushed rock from quarry to road is done, at this writing, by motor truck or horse-drawn dump wagon. A number of Mack motor trucks are in service for the longer hauls and Watson bottom-dump wagons for lesser distances. Both schemes of dumping—the automatic elevating body in the case of the motor truck, and the bottom opening leaves in the case of the wagon—are decided novelties among French road builders and their first performances were in the nature of spectacles watched with the keenest interest. Much of the road stone is delivered by the French in small, two-wheel carts hauled by a pair of horses in tandem.

The men of our road-building and quarry regiments have been divided into gangs and are quartered close to the particular jobs to which they have been assigned. At some places camps have been established and the men live in wooden barracks. Others, newly arrived, are occupying canvas tents for the present. Still others are billeted in French towns. The road service is providing everything possible in the way of good food and clothing to make life comfortable for the men. Many of the rank and file are experienced construction men, road builders or engineers with degrees from our leading technical schools, who expected to be assigned, on their arrival in France, to jobs of a supervisory capacity; for example, as bosses of gangs on road reconstruction or maintenance. Up to the present time it has not been possible for all of these expectations to be realized and men with qualifications which would ordinarily place them in positions carrying varying degrees of authority are at present swinging pick and shovel or breaking rock. When we have at our disposal a larger supply of labor battalions and have captured more prisoners it is probable that there will be a change in the status of many of our road builders who are now doing ordinary day-labor jobs. Neverthe-

less, the men are buckling down to their tasks and showing an excellent spirit.

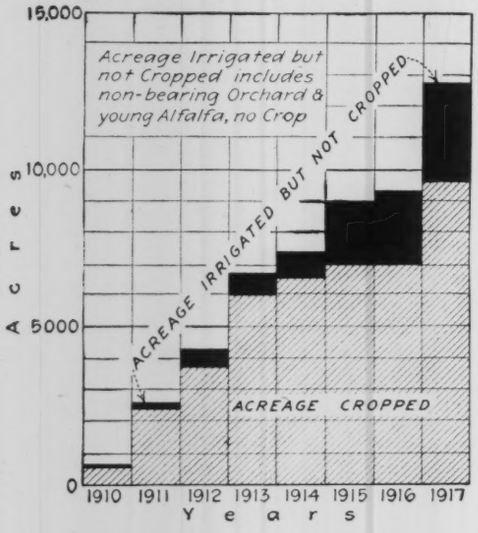
Judging by what I had to eat at one of the quarry camps there is nothing to complain of on the score of "grub." To some of us here in France who have either to pass up coffee or sweeten it with saccharine, eat brown war bread without butter and smoke French cigarettes, the lot of the military road builder, even if his job is for the time being of the routine, manual labor sort, seems to have its compensations, for he gets white bread to eat, real sugar in his coffee and American "smokes," which, in themselves, should discount many of the things which may be not quite to the liking of the man who is spreading crushed stone instead of supervising the work of German prisoners.

It is still a little early to attempt to tell the real story of our road-building work. That will come later, when all of our quarries are located, equipped and running full blast, and when our work of reconstruction and maintenance has been extended and put to the test of carrying the traffic of war for a longer time than it has done up to the present. Yet I am able to report real progress in the advance section of our road service, and I cannot do it better than by quoting from a note written to the commanding officer, lines of communication, advance section, by the general commanding the first division of the American Expeditionary Forces, behind which our road builders have been at work. Here is what the note says:

"I was very hard pressed in the sector on account of terrible roads, daily growing worse under hard usage. It was necessary to act quickly and directly with G.H.Q. Your men are doing good work. They are really saving the situation."

Orland Irrigation Project Is Sixty-two Per Cent. Settled

SPURRED on by department heads of the U. S. Reclamation Service, all of the irrigation projects last season made strenuous efforts to increase the acreage under cultivation. Yearly reports of the Orland project in California indicate that some success has been achieved along that line.



ACREAGE IRRIGATED JUMPED IN 1917

Special inducements were held out by the department waiving certain requirements as regards residence and delivery of water under the reclamation law. The number of irrigated farms increased during 1917 from 384 to 531, with an increase in area from 9359 to 12,729 acres. As the total acreage irrigable on the project is 20,490 acres, 62% was under irrigation. The number of settlers on the project increased from 1260 to 1518. That they are permanent and have sufficient capital to develop their holdings is evidenced by the substantial buildings erected, these being far above the usual "shack" type. More people have been brought into the community than during any previous year due to several reasons in addition to that of the food propaganda. In the first place the project was officially opened under public notice May 24, 1916, and under the law all land in the project not under water-right application within one year is assessed a penalty of 5% of the building cost for every year that the land remains without such application. Naturally the owners of the large holdings made every effort to dispose of their excess lands. Then, too, exceptionally attractive terms were offered in connection with the sale of these larger holdings. The land was placed on the market at prices varying from $90 to $150 per acre, 20 to 25% down, no payments from three to four years, and four to five years following for final payment, with interest at six per cent.

Slag Makes Light and Strong Concrete According to Tests

Recent tests on the properties of concrete made with blast-furnace slag at the University of Cincinnati under the direction of Prof. Curtis S. Myers give indications of the satisfactory nature of this type of aggregate. Preliminary conclusions from the experiments are as follows:

(1) Compression tests show slag and bank sand as used in 1:2:4 concrete to be 17% stronger than concrete made with pebbles and bank sand. (2) Concrete made with slag and bank sand shows greater elasticity and resistance to fracture than does pebble concrete. (3) Weight of slag and bank sand concrete is 16% less than pebble concrete for a 1:2:4 mix. (4) Tensile strength of 1:3 slag mortar is 12.5% higher than bank sand mortar and 62% higher than standard Ottawa sand mortar. (5) Bond strength of slag and bank sand concrete is 15% higher than 1:2:4 pebble concrete. (6) Slag and bank sand concrete withstands higher temperature than crushed stone and bank sand concrete. (7) Transverse beam tests comparing strength of slag and bank sand beams with crushed stone (1:2:4 mix) show slag beams to be 42% stronger. (8) Slag concrete withstands action of acids better than do crushed stone samples. (9) No appreciable corrosion of steel imbedded in slag concrete is noted at the end of one year. (10) Slag concrete resists shock or impact much more successfully than does pebble or crushed stone concrete.

Court of Claims Awards Damages to Dam Contractor

Upholds Contention That Government Revision of Plans and Breaking of Contract Cost Contractor Money

CONTROVERSIES arising out of the construction of the Shoshone Dam in Wyoming for the United States Reclamation Service have been settled by the Court of Claims by the award to the contractor of $322,164.67. Claims were made by the United States Fidelity & Guaranty Co., Baltimore, the sureties for the original contractor who defaulted, that certain Government breaches of contract caused the cost of construction to run nearly double the contract price of $515,730. The court held that some of the claims were valid.

The first claim sustained involved the closure of a diversion channel. During the period of construction it was necessary to divert the water by means of an outlet tunnel which had a guaranteed capacity of 2000 ft. per second. Notwithstanding this provision of the contract, the Government installed at the upstream portal of this tunnel certain grillages which had the effect of throttling the tunnel, and caused the work to overflow when carrying less than 1000 ft. per second. This occurred at periods when it was disastrous to the contractors, delaying the work for long periods and requiring much of the concrete to be placed in the winter at an excessive cost.

Moving Dam Site Caused Extra Work

Plan changes which caused damage relate to the location of the dam. After the award of the contract it was shown that the Government moved the dam site upstream approximately 15 ft. This required additional excavation. The plans provided for a narrow curtain wall, to be erected to a height of 18 ft. above the river bed at its upstream face prior to the erection of the main dam. The object of this was to increase the diverting capacity of the tunnel and also extend the season for prosecuting the work. Owing to the proximity of the flood season the Government refused to permit the contractors to erect this curtain wall, with the result that when high water arrived the foundation pit, 60 ft. below the river bed, was filled with rock and débris, which had to be reëxcavated on several occasions.

One main claim was disallowed. About two miles upstream from the dam, and within the proposed reservoir site, on lands which the Government held under a contract to purchase, was a saw mill with an ordinary log boom to hold logs that were cut on a Government reservation and floated downstream. This mill was maintained for the benefit of the public, but had a contract for the Government to cut more than 1,000,000 feet of lumber at a greatly reduced price. The Government required the lumber on another project. This log boom broke in 1906 and again in 1907, destroying the temporary works, which cost $100,000, and also delaying the completion of the work. The surety company contended that the Government was responsible for the continued maintenance of the log boom, as the contractors had no control over its continuance but in undertaking the work merely assumed the natural risks due to the forces of nature, while the Government had no right to increase the normal hazards by permitting the log boom to remain. The Court of Claims held, however, with reference to this item, that there could be no recovery.

The surety company was represented by its general counsel J. Kemp Bartlett, Baltimore, and Edwin C. Brandenburg, Washington, D. C. The Government was represented by Assistant Attorney General Huston Thompson and his assistant J. Harwood Graves.

Automatic Sewage Pumping Stations Serve Small Suburban District

AS WATERLOO, Iowa, expanded it took in suburban areas lower than the existing sewer system. To serve three of these districts small motor-operated automatic pumping stations have been built. G. H. Kilpatrick, assistant city engineer, told of their construction and early operation before the Iowa Engineering Society recently. Some of the problems encountered are noted below.

The Cedar River Park station serves a summer home addition of 86 persons producing 23.3 gal. of sewage each. So small was the flow the first winter that there was trouble due to freezing. A hot water radiator was placed in the 8 x 12 x 12-ft. reservoir and connected with a gas heater. The submerged centrifugal pump, which lifts the sewage 8.7 ft., has a 6-in. suction and 4-in. discharge. The 7½-hp. motor is float controlled. The brick pump house is 9 x 9 ft. inside, and has a steel frame roof covered with asphalt shingles. The cost of the concrete reservoir was $700, the pump house $265 and the pumping outfit complete $505. It is estimated that eventually there will be 510 persons using 30 gal. of water each to be cared for by this pump.

At the Fullerton Ave. station, designed to handle 27,000 gal., the 1000-gal. circular reservoir of 7-ft. diameter was built with the top 4 ft. below ground. Considerable trouble from ground water was encountered in laying the 6-in. concrete floor due to water boiling up through a seam in the rock at the center of the excavation. Three thicknesses of heavy canvas were laid on the rock in an endeavor to overcome this pressure, but without success. At the place where the water pressure was greatest a piece of concrete 2 x 2 ft. was removed, and the seam in the rock driven full of untreated yarn. Several additional layers of canvas were placed over the seam and the opening was again filled with concrete. As this failed to hold the pressure, another opening was made, a 2-in. pipe placed at the point where the water boiled the hardest, and the opening again filled with concrete. This worked successfully and later on the pipe was cut off and capped. The cost of this plant, including the circular brick house, 6 ft. in diameter, 3½-hp. motor and 3-in. pump, was $922. At present it lifts 510 gal. of sewage from 20 persons 11.6 feet.

A larger plant, the Falls Ave. station, planned to serve 10,520 persons, has a rectangular reservoir 8 x 12 x 20 ft. and an 8 x 12-ft. brick house for a 4-in. pump and a 5-hp. motor. The cost was $2775. Only one residence is connected at present, but the station handles 42,000 gal. daily from 884 employees of a factory tributary.

Motor Trucks Cheaper Than Teams on Hauling Gravel

Distributed Costs Show a Saving of About 20 Cents Per Yard-Mile—Machines Particularly Good on Harder Work

By F. P. Scott

Flathead County Engineering Department, Kalispell, Mont.

ACCURATELY distributed costs of construction work unfortunately are found only occasionally in engineering journals. In great measure this is due to an unwillingness on the part of contractors to make public information which they consider to be of a private nature, though the lack of curiosity on the part of public officials, or perhaps the absence of proper facilities on the part of these men may be responsible for much of the silence complained of above. So much of benefit to the general public would issue from a freer publication of data of this nature, that the following tabular comparison of the costs of hauling gravel for road building by motor truck and teams is given as an indication both of the writer's attitude toward the importance of the matter and of the economies which may be attained through the purchase and proper use of modern equipment.

At the time of the purchase of the truck, which was of 5 tons rating and of 5 cubic yards capacity, the intention was to use it on the greater part of the hauling. Unfortunately—at least from one angle—delivery was considerably delayed and much of the spring hauling had to be done by team. This afforded excellent opportunity for a comparison of the costs of the two methods. The data were gathered from the various jobs through the use of a standard report card kept by the foremen or timekeepers and turned in at the end of each day.

While there might be a question as to the fairness of the comparison, in that the teams did most of their work during the spring, the past season was an unusual one for this region. Roads in this section of the country in most cases dry very soon after a rain, and when last year's spring rains were over the roads were in first-class condition for about two weeks. Shortly thereafter they began to get dusty and full of sand pockets, which made hauling exceptionally difficult throughout the remainder of the season. For this reason I believe that the comparison is fair and most generous to the teams.

Included in the table are only those items which are chargeable to getting the gravel to the roads, which had previously been graded and drained. Merely as a matter of incidental information it might be said that the roadway was metalled to a width of from 12 to 14 ft., the gravel being spread with a grader or by hand and then rolled. In general it was applied in one course to a depth of about 10 in., but in some cases, where the roadway ran through wet land, two 6 in. courses were laid down. The depth of the gravel as placed is sufficient for the present traffic. There has been no attempt to provide roads for the future, but only to give relief to the largest possible territory with the money available. At the present time there are approximately 30 miles of graveled roads in the county, all of which have given very good service.

At some of the pits the "pit run" was suitable material for road surfacing—the maximum size being 2½ in.—while at other pits approximately 25% had to be wasted, which accounts for the wide variations in the loading costs. At the Keller and the Gudgel pits there was very little material suitable for surfacing and it was run through the crusher.

The accompanying table shows that the truck proved far more economical than the teams. Gravel was hauled from the Cornelison and the Funk pits by both methods, the truck being given the longer haul and the poorest roads. At the Gudgel and the Straleu pits the haul was over previously graveled roads in part. The hauling costs for teams show exceptionally high from the Dodge pit and may be traced to some extent to a hill ¼ mile long, which required a helping team and man for every six teams hauling.

Labor and supplies were paid for at the following rates: Common labor, $0.375 per hour; team and teamster, $0.75 per hour; foreman, $0.45 per hour; truck drivers, $100 per month; gasoline, $0.27 per gallon; oil, $0.52 per gallon; coal, $8.60 per ton.

The cost sheet shows that there were 34851.6 yard-miles of gravel hauled by the teams, and that the truck saved $0.196 per yard-mile; or, if all had been hauled by the truck, a saving of $6830.90 would have been made—which is a strong argument in favor of the pur-

COMPARISON OF THE COSTS OF LOADING, SPREADING AND HAULING

Pits		Loading: Labor Men	Loading: Labor Teams	Loading: Engineman	Loading: Fuel	Loading: Supplies	Loading: Repairs	Loading: Prep. Exp.	Loading: Int. Depr.	Loading: Cost per Cu.Yd.	Hauling (Teams): Labor Men	Hauling (Teams): Labor Teams	Hauling (Teams): Depr.	Hauling (Teams): Int.	Hauling (Teams): Ave. Haul Miles	Hauling (Teams): Cu.Yd. Hauled	Hauling (Teams): Cost per Yd.Mi.
Adams	Hrs.	904.00	312.00				116.00				1,292.5	1,212.5					
	Amt.	345.00	117.00				43.55		39.16	0.445	490.69	454.69	5.00	1.53	1.53	1,225.00	0.508
Anderson	Hrs.	860.00	200.00					12.00			808.00	748.00					
	Amt.	330.00	75.00					4.80	25.25	0.524	308.00	280.50	3.75	1.35	1.735	831.0	0.412
Buck	Hrs.	280.00	150.00								544.00	519.00					
	Amt.	107.60	56.25						31.94	0.363	205.89	194.64	9.75	1.17	1.815	539.00	0.421
Cornelison	Hrs.	2,570.00	1,520.00				100.00	545.00			2,880.00	2,810.00					
	Amt.	956.12	556.88			30.00	37.50	323.68	77.16	0.436	1,084.14	1,053.76	62.50	8.10	1.536	3,676.00	0.391
Dodge	Hrs.	1,665.00	500.00				70.00	400.00			2,685.00	2,890.00					
	Amt.	670.80	187.50				26.25	150.00	27.00	0.872	994.50	1,083.75	23.50	2.70	2.125	1,218.00	0.813
Funk	Hrs.	1,916.00	1,010.00				230.00				2,391.00	2,370.00					
	Amt.	762.63	378.76				86.25		62.00	0.419	899.48	888.78	45.00	3.00	1.73	26.92	0.394
Good	Hrs.	508.00	218.00								504.00	592.00					
	Amt.	193.40	81.75						19.57	0.533	192.15	222.00	2.50		1.162	553.00	0.648
Keller	Hrs.	3,498.00	1,495.00					184.00			2,422.00	2,092.00					
	Amt.	1,328.61	561.97	390.00	146.61	10.00	20.00	87.08	151.21	0.598	930.16	784.42	9.90	3.24	1.055	4,503.5	0.364
Reddick	Hrs.	505.00	220.00					130.00			1,289.00	1,219.00					
	Amt.	186.00	82.50					92.25	46.61	0.350	481.91	457.16	19.50	2.34	1.760	1,163.00	0.469
Sheldon	Hrs.	1,582.00	776.00								2,879.00	2,787.00					
	Amt.	599.99	290.95						56.62	0.298	1,086.19	1,045.08	13.50	1.62	1.934	3,178.00	0.349
Straleu	Hrs.	603.00	171.00	90.00			18.00	444.00									
	Amt.	250.76	76.00	45.00	32.01		15.19	288.78	45.50	1.506							
Winston	Hrs.	872.50	256.50					203.00			1,995.00	1,870.00					
	Amt.	356.45	97.57			30.75		77.63	6.89	0.354	757.55	701.30	11.25	1.35	2.202	1,607.00	0.416
Gudgel	Hrs.	2,133.00	785.00	238.00	20.17 ton		44.60	697.00			239.50	191.50					
	Amt.	815.52	305.27	125.00	197.58	21.70	18.70	272.89	141.37	0.971	115.58	79.33	4.00	1.00	0.704	767.00	0.370
		6,902.88	2,867.40	560.00	376.20	92.45	247.44	1,297.11	730.28	0.526	7,546.24	7,245.41	210.15	27.40	1.588	21,952.50	0.431

chase of another truck. Under present conditions the use of the truck by itself has made the loading cost higher than it should be, as it does not work the loading equipment to full capacity. It is believed that the hauling cost for another season can be cut to $0.20 per yard-mile.

The engineering force is composed of A. L. Saunders, county engineer; Milton Hoidal and F. P. Scott, deputies.

Railway Bridge Over Upper Niagara River

Construction of a new railway crossing over the upper Niagara River is planned, according to a bill before the Canadian House of Commons, reported by the Railway Committee on April 30. The bill would incorporate the Canadian Niagara Bridge Co., Ltd., among whose directors are Baron Shaughnessy and A. H. Smith, the president of the New York Central Railroad.

The crossing, which is to be open to all railways, will cost, it is estimated, about $7,000,000. The bill as reported by the committee requires the bridge to be built at least two miles upstream from Chippawa Creek, so as not to interfere with the plans of the Ontario Hydro-Electric Commission, requires that a roadway for vehicle traffic be provided, and requires work on the crossing to be started within two years and completed within five years.

Simplify Office Work of Handling Emergency Building Program at Navy Yard

System Enables Public Works Officer to Administer Many Contracts, Running into Eight Figures, Without Overlooking Details—Progress with Records Simply Kept—Mail Routing Slips Prevent Letters Being "Buried"

THE problem of administering and supervising the execution of a large number of contracts, many of an emergency nature, at a navy yard, requires an organization adjusted so that every question may be decided promptly. A system which provides a visible record of each contract and of the status of every question on which decision is pending in relation to the work is an important feature. A large amount of day labor and other work is also covered by the organization, which is headed by the public works officer of the navy yard.

The principal subdivisions of the office and their heads include:

General yard development, maintenance and repairs—assistant civil engineer.

Day labor work—two assistant civil engineers, one in office and one outside.

Yard transportation, expediting shipments, sand and gravel production and distribution under commandeer orders—supervising engineer.

Records and clerical—chief clerk.

Design, drafting, checking plans, etc.—chief draftsman.

Electrical and mechanical installations and contract inspection of similar work—electrical aid.

Engineering contract inspection—expert aid.

A supervising engineer acts as a general assistant to the public works officer, particularly in the more important engineering matters, and a stenographer acts as a secretary.

The inspection force is further divided into a number of sections, each under an experienced man who is responsible for the proper inspection of all contracts under him.

Each of these section inspectors has under him a chief inspector for every contract, who is in charge of the inspection work on that contract. Under each of these chief inspectors is a sufficient force of pile inspectors, concrete inspectors, etc., to cover the work thoroughly. On the larger contracts the chief inspector has also enough men to do all the necessary surveying for the purpose of giving lines and grades or making estimates

GRAVEL BY TEAMS AND BY MOTOR TRUCKS AT THIRTEEN MONTANA PITS

Spreading			Hauling (Truck)												
Labor Men	Teams	Int. and Depr.	Operator	Repairs	Fuel	Ave. Haul	Cu.Yd. Hauled	Int. Depr.	Cost Yd. Mi.	Miles of Gravel	Superintendence	General Exp.	Total Cost	Unit Cost per Yd.	Cu.Yd. per Mile	Unit Cost per Mile
276.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.20	24.80	19.00	1,643.92	1.342	1,021	1,369.93
103.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.75	12.45	29.15	1,172.25	1.411	1,108	1,563.00
272.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.41	7.00	8.00	665.74	1.235	1,315	1,624.00
102.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.07	55.00	40.00	5,257.45	1.158	900	1,037.00
115.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.90	28.00	15.00	3,346.73	2.584	1,353	3,719.00
43.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.31	57.00	25.00	3,866.76	1.256	930	1,168.00
196.00	73.00	.....	242.00	5.00	.....	.....	.....	.....	.....	0.50	7.00	6.50	775.31	1.402	1,106	1,551.00
412.14	21.76	4.50	93.12	30.40	113.51	2.114	865	297.18	0.292	2.55	58.00	53.00	4,871.96	1.082	1,766	1,910.57
330.00	40.00	.....	.....	.....	.....	.....	.....	.....	.....	0.89	19.00	16.00	1,489.48	1.281	1,307	1,674.00
123.75	14.00	.....	.....	.....	.....	.....	.....	.....	.....	2.50	60.00	35.00	3,248.78	1.022	1,271	1,300.00
830.00	95.00	.....	100.00	20.00	.....	.....	.....	.....	.....	0.45	6.20	5.00	997.49	1.995	1,111	1,995.00
311.20	35.63	5.00	38.50	10.85	54.86	2.41	385	152.82	0.277	1.76	51.00	30.00	2,332.56	1.4515	913	1,325.32
116.00	18.50	.....	.....	.....	.....	.....	.....	.....	.....	1.25	25.00	22.50	2,753.72	1.409	1,563	2,203.00
43.50	6.94	.....	.....	.....	.....	.....	.....	.....	.....							
780.00	108.00	.....	.....	.....	.....	.....	.....	.....	.....							
291.76	40.50	5.50	.....	.....	.....	.....	.....	.....	.....							
230.00	.....	.....	.....	.....	.....	.....	.....	.....	.....							
86.21	.....	.....	.....	.....	.....	.....	.....	.....	.....							
83.00	64.00	.....	.....	.....	.....	.....	.....	.....	.....							
31.08	24.00	4.75	.....	.....	.....	.....	.....	.....	.....							
118.00	.....	.....	117.00	16.00	.....	.....	.....	.....	.....							
41.69	.....	.....	55.93	24.62	52.31	2.416	500	58.50	0.158							
523.00	30.00	.....	.....	.....	.....	.....	.....	.....	.....							
196.13	11.19	3.50	.....	.....	.....	.....	.....	.....	.....							
355.00	.....	.....	247.00	25.00	.....	.....	.....	.....	.....							
151.45	.....	.....	104.50	65.72	99.95	1.805	1,187	186.66	0.213							
1,937.91	154.02	23.25	292.05	131.59	320.63	2.079	2,937	695.16	0.235	21.54	410.45	304.15	32,422.15	1.303	1,156	1,505.00

for payment. Each section inspector is also able to organize a survey party for these purposes without disarranging the work of his chief inspectors.

Each contractor, when a job is awarded to him, is required to submit a progress chart showing the dates on which he anticipates commencing and finishing the major items of work in his contract. These charts are plotted on cross-section tracing cloth, and on them are posted weekly the actual quantities of work done. It is thus an easy matter to ascertain whether or not the work is progressing as anticipated.

Once a month each section chief makes a report of the amount of work done and the quantities of material used on all contracts under his charge. After this has been checked against an independent estimate prepared by the chief estimator, a voucher is prepared for monthly payment.

Before beginning work, contractors are required to submit for approval samples of the various materials entering into their construction. These samples are compared with the specification requirements, are accepted or rejected in writing, and a typewritten sheet is glued or tied to each sample, showing the contract to which it pertains and a reference to the letter accepting or rejecting it. A room has been fitted with shelves and a space provided for each contract, where all the samples submitted for that work are assembled for convenient reference. When delivery of materials begins, inspectors compare the accepted sample with the material actually delivered.

With a large number of contracts under way, it is inevitable that many differences of opinion regarding final settlements should arise, and it is absolutely necessary to keep a complete and accurate history of every contract. This is accomplished by having each inspector make out a daily report, showing not only the amount of work done but the points at which work was being prosecuted, the reasons for changes and delays, and all other matters that might have a bearing on the final adjustment. From these reports is made, semimonthly, a typewritten digest of the work accomplished on each contract. These digests frequently furnish sufficient information for settling questions that arise, and when more detailed data are required, it is easy to trace the matter back to the original daily reports. As soon as a contract has been wound up, the reports for that contract are bound and filed.

Another most important feature of the organization is the expedition of correspondence and other matters relating to the large number of contracts. Such matters are handled in what is thought to be an unusual and very effective manner. Each letter or paper relating to a question which should be handled by one of the assistants is attached to one of the small slips shown herewith, which shows the name of the firm or person from whom the papers have come, the date received, a consecutive number, the subject, the name of the man to whom it has been referred, and the date of reference. These slips are made out in triplicate. On a large board secured to the wall in the office of the public works officer are a number of columns, each of which is headed by the name of an assistant. Under each of these names is thumb-tacked, in consecutive order, one copy of each slip describing matters that have been referred for action to the man whose name heads the column. When action has been taken, the letter answered, etc., the papers in each instance come back to the public works officer for his information; and as soon as received, the slip relating thereto is removed

FROM:

DATE: Let No. End. No.

SUBJECT:

REF'D TO:

DATE:

from the board. One copy of each slip also goes to the file clerk for his information.

It is thus possible to trace any matter which has come up for decision and has not been dealt with promptly. Moreover, it is easy to tell in general how promptly each man is disposing of his important business, and to follow up matters requiring special haste without waiting for further reminders from the original correspondent. The board also indicates at a glance how much of a load each one of the assistants is carrying.

The system outlined has enabled the public works office in question to take care, without confusion or delay, of its tremendously expanded construction business and furnishes an unusual degree of insurance against the sidetracking of important matters. The public works office is under the commandant of the navy yard and the Bureau of Yards and Docks of the Navy, of which Rear Admiral C. W. Parks is chief.

San Juan Camp Water-Supply Problems Met

Encampment of 12,850 prospective soldiers within the city limits of San Juan, Porto Rico, put a heavy increased demand upon the municipal water-works. The problem hinged largely upon the fact that the pumps are driven electrically under a contract for current which provides a rate of 10c. per kw.-hr. during the 4-hr. peak-load period of the electric company, and only 2½c. throughout the other 20 hours of the day. To take advantage of the lower rate in dealing with the increased water consumption and to improve the pressure in the higher parts of the city, it was decided to install a booster pump at the reservoir and to build two steel tanks 65 ft. high from which the water will flow to the consumers.

The water-supply of San Juan is pumped from the Rio Piedros and is treated by six mechanical filters. Two 150-hp. motors operate two centrifugal pumps with a daily capacity of 3,000,000 gal. Six more filter units will be provided. The city will supply the water to the cantonment without charge. The water-works enlargements are being made under the engineering direction of Ferdinand Montilla. The foregoing information has been supplied by M. Ferrer, who is the city engineer of San Juan.

Traffic Density Does Not Justify Building Roads for Heavy Trucks in Philippines

One-Ton, Two-Wheeled Bull-Cart Is the Natural Traffic Unit—Subgrade Conditions None Too Good—Study of the Circumstances of Success and Failure Indicated as the Correct Basis for Such Decisions

By J. L. Harrison
Formerly Supervising Engineer, Bureau of Public Works, Manila, P. I.

ANY decision as to the type of road most suitable to the conditions existing in the Philippine Islands must be based on the realization that the two-wheeled cart drawn by a carabao, a heavy native water buffalo, is the natural traffic unit and will eventually drive out motor-truck competition—for the wages of a cart driver and the cost of keeping a carabao are so low that, under present conditions, automobile transportation cannot possibly compete with them. In fact, it is probable that a one-ton bull cart, together with a carabao and a driver can, even now, be secured for 50c. a day in some localities. A well-tended bull will travel from 12 to 20 miles a day, half of it under load, so that the normal price of cart transportation over level roads may be expected to drop well under 7c. per loaded ton-mile—a figure that no automobile truck has as yet been able to approach.

It was natural, therefore, that the roads constructed in the Philippine Islands should have been built to carry loads of this type, and it must be recorded here that the system has been entirely successful in meeting the needs of the traffic for which it was designed.

By the end of the year 1916 the government of the Philippine Islands had completed 2132 miles of first-class roads, 1268 miles of second-class roads, and 2133 miles of third-class roads. The first-class roads are, for the most part, either gravel or broken-stone construction from 6 to 8 in. thick and from 11 to 20 ft. wide. Most of the second-class roads are also metalled, but usually the metalling is either thinner or laid without as much care in the preparation of the subgrade. Both first- and second-class roads are designed to be open for traffic during the whole of the year—and both are carefully maintained. Second-class construction is now permitted only on routes where it seems evident that heavy traffic will not develop. The total cost of all roads built prior to Jan. 1, 1917, was about $22,500,000, more than $18,000,000 of which had been spent on the first- and second-class roads. For the first-class roads the cost of the metalling, including placing and rolling, may be taken as about $2400 per mile.

However, the distribution of animals in the Philippine Islands is irregular, and consequently there are many localities where the price of cart transportation is now from 2½ to 3½ times what may be fairly considered normal. These high costs are well above the price at which trucks can be operated profitably. So during the past three or four years there has been a constant importation of trucks with a general tendency to bring in heavier and heavier machines. The road system has therefore been called on to carry loads for which it was not designed, and, as might be expected, the result has been decidedly unfortunate. As a consequence of these conditions the problem may be fairly stated as follows: Given a system of over 3400 miles of improved roads, which has cost more than $18,000,000 and which must be considerably extended in order to meet even the present needs of the community, and given an increasing track traffic which is ruining large sections of the present road system, should the Government (1) reconstruct those parts parts of its road system where truck transportation is likely to increase, and so meet the ever-increasing weight of

modern trucks? or (2) should the Government prohibit the use of trucks which are too heavy for the present road system?

The evidence as to what loads the roads of the Philippine Islands will carry is negative rather than positive. Roads have failed in the Province of La Laguna, where trucks of various sizes up to ten tons were used. In Leyte an extensive and valuable road system was largely destroyed by 3- and 5-ton trucks. Some of these machines hauled trailers. In Cebu and near Zamboanga 3-ton trucks have seriously damaged first-class roads. In Camarines the road system has carried 1½- and 2-ton trucks that have been carefully operated, but maintenance costs have been unduly heavy. In Bulacan the roads have given good service under a heavy "jitney" traffic operated at from 15 to 20 miles an hour. Old automobiles, but no trucks, have been used in this service.

Trucks Raise Maintenance Cost

These and other similar instances could be cited to show that wherever trucks carrying over a ton have been used in any number, there has been a noticeable rise in the cost of maintenance; and where trucks carrying over two tons have been used, road failures have resulted and extensive reconstructions have been necessary. It therefore may be justly asserted that 1-ton trucks are the heaviest which the Philippine roads can now safely carry. This is about what should be expected, for while the unit wheel load may be heavier under a fully loaded cart than it is under a 1-ton truck, the truck really produces much more strain in the pavement. Especially is this true on a gravel or macadam pavement which is a little rough. In these cases the bull-cart, moving at a rate rather under two miles an hour, produces little if any strain in excess of its dead load weight.

Another feature of the situation which is of importance in the Philippine Islands is the low carrying capacity of the typical subgrade. The rainy season is long, the rains are heavy, and as a result subgrades are softened to a point where they will carry distinctly less than what would be counted normal in the United States. This is a matter of importance in judging the merits of the work done by the bureau of public works, but has no special bearing on the specific problem in hand.

As it appears that 1-ton trucks can be operated on the present road system of the Philippine Islands, but that when heavier trucks are used the present roads will probably be damaged or destroyed, it would seem logical to determine what added expense would be necessary to improve them so that they would carry the heavier trucks. As practically all the failures so far recorded have been subgrade failures, it would seem logical to assume that the allowable unit compression under the pavement would be about right if kept down to the compression caused by 1-ton trucks operating over a standard 6-in. metalling.

The amount of this compression can be closely approximated by assuming that there is a total load of 1300 lb. on each of the rear wheels of a fully loaded 1-ton truck, that the wheel is 3 in. wide and bears on the pavement in a rectangle 2 in. x 3 in. and that the load spreads out at an angle of 45 deg. from the area on which it is applied. It would perhaps be fair to double or even quadruple this assumed dead load in order to allow for impact, especially if iron tires are used, but as relative loadings are all that is needed in order to compare the various forms of trucks, and as the factor to be used for impact is pretty constant for the various sizes of trucks when they are operated under actual commercial conditions, no allowance for impact will be made in this discussion. Similarly, a 3-ton truck will be assumed to impose a rear-wheel load of 3300 lb. per wheel distributed over a pavement area 2 in. x 4 in.; a 5-ton truck, a maximum wheel load of 5000 lb. transmitted to the pavement through an area 2 in. x 6 in.; and a 10-ton truck, 9000 lb. delivered to the pavement on an area 2 in. x 10 in. Different makers build trucks so that various proportions of the load are thrown onto the rear axle, but it is thought that the above assumptions are reasonable and fair.

Returning to the 1-ton truck, a simple arithmetical calculation shows that under the above assumptions a 6-in. pavement distributes the rear wheel load over about 190 sq.in. of subgrade, which is equivalent to approximately 6½ lb. per sq.in. To keep the load on the subgrade within this limit, the load from a 3-ton truck should then be spread over an area of 508 sq.in., the load from a 5-ton truck should be spread over 770 sq.in., and the load from a 10-ton truck over 1380 sq.in. To secure such a distribution of the load, a pavement thickness of slightly over 10 in. is needed to carry 3-ton trucks, of 13 in. to carry safely 5-ton trucks and of a little less than 18 in. to carry 10-ton trucks. It therefore appears that to justify the use of 3-ton trucks in the Philippine Islands the metalling on the average highway should be made 4 in. thicker than it is at present; to justify the use of 5-ton trucks, the average road should be made 7 in. thicker, and to carry 10-ton trucks the increase in thickness should be about 12 inches.

Cost of Surfacing

If the metalling is made materially thicker than it is at present, considerable extra work on the shoulders, slopes and ditches of existing roads will be necessary. Surfacing, including placing and rolling the stone used, costs about $400 per mile per inch of thickness, varying from as little as $240 to as much as $560 or more. Allowing for improvements to shoulders, slopes and ditches, it would appear that to thicken existing road crusts sufficiently to carry 3-ton trucks would cost about $1800 per mile; to improve them enough to carry 5-ton trucks would cost about $3200 per mile, and to improve them to a point where 10-ton trucks could be safely used would cost at least $5600 per mile. A law passed a year ago limits the weight of a truck and its load to eight metric tons or nearly nine tons. To carry such loads the crust of Philippine roads should be increased to a thickness of about 14 in., which would represent an outlay of nearly $4000 per mile. To extend this improvement over the whole system of first- and second-class roads in existence on Jan. 1, 1917, would cost at least $13,500,000.

In these remarks and deductions it is assumed that present subgrades are satisfactory. This is not strictly true, but as this assumption favors the trucks it is thought best to permit it to stand.

There are a good many provinces where the connected system of first- and second-class roads exceeds 125 miles. In a number of these provinces the automobile traffic is increasing rather rapidly, so that some of them seem to face the necessity of providing roads that will at least carry the trucks now permitted by law. This would mean the spending of about $500,000 in each such province, and besides the fact that this expenditure would all be for the purpose of permitting the operation of heavy transportation units where light units can now be used at all times, it would probably stop all extensions to the existing road system for a period of at least five years. It would seem fair, therefore, to demand that before proceeding with the improvement of the present system to any such extent as this it should be clearly proved that such improvement would pay—for it should be clear that the present system will now meet all the reasonable demands of all forms of traffic except trucks carrying loads in excess of one ton. In other words, the reconstruction of the highways in any locality should be considered only after it has been clearly shown that the difference in the cost per ton mile between 1-ton trucks and heavy transportation units is sufficient to provide for the additional expense of building highways thick enough to support the heavy units.

Safety of Pavements Jeopardized

It may be confidently asserted that if any community permits the indiscriminate operation of all sizes of trucks it needlessly jeopardizes the safety of all of its investments in paved streets and highways, for obviously all pavements have an ultimate strength, and to exceed this ultimate strength will ruin a pavement just as certainly as it will ruin a bridge. Moreover, every community has some normal standard road improvement which will meet the general needs of the community. If special forms of traffic units are devised which threaten the destruction of the normal types of pavement, or for safety require extensive improvements, some advantage commensurate with the losses to be sustained by the public should be shown before the operation of such units is permitted. This seems to be self-evident.

It then becomes pertinent to examine the relative ton-mile cost of operating different sizes of trucks. As this is a broad study by itself, and for obvious reasons one likely to cause heated debate, no comparative figures are here set down. For not only is it true that the costs of operating different makes of trucks differ greatly, but it also is true that there is wide difference in the cost of operating different machines of the same make and size. However, any engineer who desires to follow this method of ascertaining what weight of truck is allowable in the district in which he works can easily construct a table of comparative cost that will fit his needs.

Now, it has been shown that it will require an expenditure of $4000 per mile to improve the present highways of the Philippine Islands sufficiently to carry the trucks now allowed by law. Moreover, it would be necessary largely to resurface all roads every five years, as well as to increase considerably the annual cost of maintenance, if large units are placed on the roads. The first of these items may be expected to cost $1600 per mile every five years, half of this chargeable to the extra wear caused by the heavy truck units. Experience has shown that current maintenance costs are also increased by heavy truck traffic, due to the more rapid abrasion of the surface stones. In a number of cases this increase has been a good deal more than $400 per mile per year. But it is thought that it could usually be kept down to this figure if the metalling were thick enough so that the subgrade would hold. Thus there is an increased maintenance and repair cost of $720 per mile per year, which must be met where large trucks are permitted to use the highway. This does not provide for amortizing the original investment.

To be extremely liberal, assume that $80 per mile per year will amortize the original cost of these improvements during the useful life of the pavement. The total annual cost of reconstructing a road so that it will carry the trucks now allowed will therefore be about $800 per mile. To justify such an expenditure at a difference of, say, 5c. per ton-mile between the cost of hauling in 1-ton trucks and in 5-ton trucks would require the handling of 20,000 tons of freight over each road improved. As no such amount of traffic is now or will in the immediate future be handled by trucks over any number of the roads, it seems evident that such improvement is not now justified.

In the Philippine Islands the case is further complicated by the fact that the bull-cart is the natural traffic unit, and that as the number of animals increases the regions where trucks can be profitably operated, except in the handling of passengers, will be constantly more and more restricted. This is an argument against increasing the carrying capacity of highways only when it can be shown, as it has been here, that there is reason for believing that the reduced transportation costs would not cover the actual cost of making the improvements. Under the special conditions which prevail in the Philippine Islands, there can be no doubt that where animals are plentiful no concessions should be made for the purpose of stimulating the ownership of trucks.

Motor Trucks and Animal Supply

But animal diseases are common in the islands and as a result there still is a considerable chance that communities, or even whole regions, may at any time be left practically without work animals. So it is not advisable to create a condition where animal transportation would become the sole dependence of the islands. On the other hand, it is equally poor policy so to stimulate truck traffic that the development of adequate herds of work animals is obstructed.

Another matter of importance is the progress in the extension of the road system. Assuming, for instance, that the present road system will carry a heavy volume of traffic in 1-ton trucks, but that it can be shown that there is enough traffic to warrant the construction of a heavier surfacing for heavier traffic units, it might still be inadvisable to make such improvement, for it would undoubtedly be found that the available funds could be even more advantageously used in improving unsurfaced roads than in reducing the unit cost of transporting goods over the routes already improved. This would practically always be the case in the Philippine Islands where, as a matter of fact, there still exist

many unimproved roads which are now impassable during much of each year and over which the local products can never be transported for a reasonable figure.

A typical case of this nature recently came to the writer's attention. The road from Iloilo to Leon, Iloilo Province, is about 16 miles long. Of this road 13 miles had then been improved. During the wet season, lasting from six to eight months each year, all of the products from Leon had to be packed to the end of the improved road where they were loaded on carts and taken to Iloilo. It took from six to eight hours for a man to pack a load from Leon to the end of the improved road, and it required from twenty to thirty packloads to fill a cart. If the men and women who did this packing received an average of 20c. per day, bringing enough material to the end of the improved road to fill a cart must cost an average of about $5. To haul it into Iloilo cost $3 or less, depending on the time of the year. In other words it cost about seven times as much per ton-mile to transport goods over the unimproved road as it cost to transport them over the improved road, and there was also a further serious loss due to the fact that there necessarily were many valuable products which could not be moved at all because the transportation costs were prohibitive.

Cost of Transporting Farm Products

Such illustrations could be multiplied, but this is typical of the fact that the difference in the cost of transporting farm or other products over unimproved roads as compared with the cost of transporting them over improved roads may be so much greater than the difference in the cost of transporting similar products over improved roads in, say 1-ton units as compared with the cost of transporting similar products in large units over roads specially constructed for such traffic, that it often is economicly more advisable to provide an improved road for a comparatively small tonnage than it is to provide a specially constructed highway fit to carry heavy trucks—even where heavy traffic exists. The fact that there still is a large mileage of unimproved road in the Philippine Islands, and that the financial condition of the islands is such that a policy of extensively improving the present system would probably stop extensions, makes economicly unsound the improvement of any large proportion of the present system for the sole purpose of justifying the use of large trucks.

As a result one is constrained to feel that the proper policy for the Government of the Philippine Islands is to prohibit the use of trucks that are too heavy for the existing road system. For the present, at least, this would mean the elimination of all trucks carrying more than one ton.

The data and the arguments herein set down have been prepared and submitted because it is thought that the lines of reasoning which have been used in arriving at the above conclusions may be of interest to those who are attempting to meet the question as to how to control the truck problem on American roads. As the matter now stands, there is little or nothing to prevent the ambitious owner of a large truck from destroying thousands of dollars' worth of valuable pavement by the simple process of hauling a few excessive loads over it when the subgrade has lost its supporting power due to protracted rains or spring thaws. Only an extremely short-sighted public policy could permit any such thing.

It is in the interest of the public as a whole to limit the maximum size of trucks so that a reasonable factor of safety is preserved on all improved roads. This would probably reduce the allowable maximum size of individual units to somewhat less than the present standard 5-ton machine and might, in some regions, reduce it considerably below this. No doubt many will consider this a drastic reduction, but it is confidently predicted that if the conditions in any state are examined from the standpoint set down above, the undesirability of trying to build highways for excessively large units will become apparent. Moreover, truck builders should actively favor a uniform policy as to the maximum size of machines and a reasonable maximum; for, taken by and large, such a restriction would not only reduce the number of sizes to be handled in their factories, and so reduce factory costs, but would also make the extension of the present highway system more certain and more rapid. For, once maximum loads were determined on and enforced, pavement failures would be less frequent and public liberality in voting funds for improvements correspondingly increased. Individual owners might object for a time, but in the long run even they could probably be brought to see that a reasonably low maximum is better for all concerned than an extremely high maximum.

There can be no doubt that some limit must be placed. Philippine conditions indicate that it should be a low one, but whatever it is, low or high, a limit should be placed at once—for the present conditions are unsound and intolerable.

Kinks in Water-Waste Detection at Oak Park, Ill.

CAUSES of persistent high water bills, where such bills are the subject of complaint, are determined at Oak Park, Ill., by means of a recording detector, as described by H. P. Matte, engineer and manager of the water department, in a paper read at the annual meeting of the Illinois section of the American Water-Works Association, Apr. 16. This device is substituted for the meter and gives a graphic record of the consumption for a day or a week. It enables the department to spot the number of times the faucets are opened, the number of baths and quantity used each time, and the number of times the toilets are used. In this way various methods of waste may be detected.

Installation of recording pressure gages and a master meter directly on the distribution system is used as an aid in estimating the rate of night consumption due to leakage, in noting the daily progress in stoppage of leaks, and in determining the necessity for a water-waste survey. Large districts often are shut down for a few minutes, and the drop is then noted on the venturi chart. This is done during daytime periods of steady consumption when there is a velocity of 2000 to 3000 gal. per minute, as this venturi meter is not sensitive enough under the low velocity at night. The drop is sufficient for an analysis of leakage conditions in the district. Use of the pitometer, however, is considered the surest way of making such an analysis.

Short-Lived Attempt To Unionize Baltimore City Departments

All Grades of Labor in Water and Other City Departments Delivered Ultimatum—What City Did When 2000 Laborers Quit

By Walter E. Lee
Water Engineer, Baltimore

EFFORTS to organize the day laborers of the municipal departments of Baltimore were begun about Mar. 11. Within three weeks the American Federation of Labor had formed a City Laborers' Union which included all classes of unskilled, semi-skilled and skilled laborers in the water, highway, street-cleaning, park, health and fire departments, as well as the teachers in the department of education.

Before proceeding it may be noted that the policy of the city has always been to pay its labor a higher wage than that prevailing in the labor market. Thus, when the city paid, prior to 1911, $1.66 per day, the outside rate was $1.50. In May, 1911, when the city advanced its wage to $2 per day of eight hours, the outside rate was $1.75. On Jan. 1, 1917, when the rate was again advanced to $2.25 per eight-hour day, the outside rate was $2. On Jan. 1, 1918, the rate was again advanced to $2.40 for eight hours or 30c. per hour, with outside rates among private contractors 30c. per hour, and with rates on nearby Government cantonments 32c. per hour. To resume its former position in advance of the labor market, Baltimore on Mar. 9, 1918, again voluntarily advanced its wage to $2.76 for an eight-hour day, or 34½c. per hour, which at the present time is 1½c. in advance of the outside hourly rate. Opportunity was afforded to 'drag" or make overtime on straight pay for 10 hours.

The demands made by the municipal laborers in March were: (1) recognition of the City Laborers' Union (2) $3 for an eight-hour day or 37½c. per hour; time and a half for overtime after eight hours; double time for work on Sundays and specified holidays.

The city received notice that if these demands were not met by Apr. 1 the entire city labor force would quit work. The city did not meet the demands and approximately 2000 municipal employees of all grades in the departments named, with the exception of firemen and school teachers, quit. By means of pickets in the 24 wards of the city and at the various yards and construction offices of the departments efforts were made to prevent those loyal employees from working further for the city.

An attempt was also made to shut down the sewage pumping station, which would have caused the accumulation and back flow of house sewage in house closets in the low level district. Effort was also made to cripple quarantine inspection of inbound foreign vessels, by abandonment of quarantine inspection tugs by their crews. Quarantine inspection is made at a point four miles below the harbor of the city, and prevents the importation from abroad of contagious and infectious diseases. All paving work and all horticultural and construction work in the parks was brought to a standstill.

The city met the strike in the water-filtration plant and water- and sewage-pumping stations by doubling up the time of the loyal men, and other technically trained men of the department threw themselves into the gap. The accumulations of ashes and garbage were not collected, but instructions were issued to householders to burn all combustible rubbish and to incinerate their garbage as far as possible. Partly paved streets were left in that condition, properly safeguarded against accidents to traffic, and gardening work in the parks was suspended. The quarantine issue was met by making inspections in the inner harbor just before foreign vessels docked, so there was no need of tugs.

After 15 days, the strength of the City Laborers' Union waned, and 30% of its members returned to work with the municipal departments of the city at the rate of 34 ½c. per hour for common day labor, with an adjustment in higher rates on semi-skilled and skilled labor which had been determined on before the walkout.

Motor Truck Plays Large Part in Growth of Bridge Traffic

INCOME from traffic tolls on the Interstate bridge over the Columbia River between Portland, Ore., and Vancouver, Wash., paid all fixed charges besides operating expenses in the first year after completion. No taxes have had to be levied by the two counties (which own the bridge) in connection with the entire improvement. Interest during construction was paid by one of the counties out of the original bond issue, while the other county's share was paid by the state.

The bridge was opened to traffic in February, 1917 and March was the first full month of service. With the beginning of the current month a year's records became available. E. E. Howard, of Harrington, Howard & Ash, consulting engineers, Kansas City, gives the traffic statistics for March, 1917, and March, 1918, as summarized in the accompanying table. A large increase in motor traffic and a decrease in all classes of horse-drawn traffic is shown. Measured by total receipts the traffic has just about doubled during the year. Automobile and motor-truck traffic more than doubled, while traffic of livestock and four classes of horse-drawn vehicles decreased.

The tolls charged are substantially the same as the former ferry rates. Thus the improved service afforded by the bridge, as compared with the ferry, is obtained without increase of cost to the traveling public and without expenditure of public money.

MONTHLY TOLL TRAFFIC RECORD OF INTERSTATE BRIDGE OVER COLUMBIA RIVER

	March, 1917		March, 1918	
	Number	Tolls Collected	Number	Tolls Collected
Persons	41,105	$2,055.25	87,679	$4,383.95
Self-Propelled Vehicles:				
Motorcycles	756	37.80	682	34.10
Autos, 8-passenger and ½-ton trucks	2,427	242.70	5,066	506.60
Autos, 2-passenger and 1-ton trucks	10,979	1,646.85	25,401	3,810.15
Autos, over 8-passenger and 2-ton trucks	647	161.75	1,333	333.25
Trucks over 2 tons	182	91.00	409	204.50
Horse Drawn Vehicles:				
1-horse vehicle	488	48.80	407	40.70
2-horse vehicle	994	149.10	814	122.10
3-horse vehicle	36	9.00	19	4.75
4-horse vehicle	15	5.25	11	3.85
Livestock	593	25.24	530	26.50
Street cars	4,568	1,142.00	6,322	1,580.50
Street-car passengers	67,912	2,376.91	158,318	5,541.13
Total tolls		$7,991.65		$16,592.08
Daily average		$257.80		$535.23

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Classification of Engineering Literature

Sir—I have read with much interest Kenneth C. Walker's communication on p. 780 of *Engineering News-Record*, Apr. 18, entitled, "Why Propose Another Classification of Engineering Literature?" also the reply by Chas. Warren Hunt, secretary of the American Society of Civil Engineers. I am very glad to see the matter of standardizing a classification for engineering literature stirred up in this way.

There is much to be said on the pros and cons of the Dewey system for various purposes, which discussions have been going on at intervals for many years; and, of course, Messrs. Walker and Hunt and many others of us long to see matters brought to a head. Let me therefore offer this suggestion: That the American Society of Civil Engineers or any other engineering society of national scope, or any other organization that consists of a goodly number of members of the engineering profession, request the American Library Association (78 East Washington St., Chicago) to recommend a classification which it deems worth while for any one branch or for all branches of engineering, and couple with this request a statement that if the recommendation should be received by the first of the year, the favor would be much appreciated.

What would be likely to happen? If the request were received at the American Library Association headquarters before the last of June, it would probably be brought up at the Saratoga convention of the Association (July 1-6), and duly referred to a committee which would in all probability give the matter serious consideration and have its answer ready by the first of the year or considerably sooner.

In any consideration of the subject of classification, cognizance should be given to the fact that much valuable work has already been done, yet left hanging in the air. Particular mention should be made of the splendid efforts [interrupted by the war?—Editor] of W. P. Cutter, librarian of the United Engineering Societies, and his colleagues on the Joint Committee on Classification of Technical Literature [representing more than thirty organizations.—Editor], outlined in *Engineering Record*, May 29, 1915, p. 696, and April 8, 1916, p. 496.

G. W. LEE.

Boston, Mass. Librarian, Stone & Webster.

Uniform Sizes for Catalogs

SIR—During the forty years that the writer has been a subscriber to *Engineering News* and *Engineering News-Record* there have appeared more than a hundred articles advocating uniform catalog sizes. The latest of these, by Major Edgar A. Rossiter, appeared in *Engineering News-Record* of April 25, 1918, p. 830.

To compel a uniform catalog size would require an edict of the President of the United States. Major Rossiter mentions at least five sizes—fifty would be nearer the truth—and yet he wants to add another and a peculiar size, 10 x 7½ in., which is as *arbitrary* as the sizes he condemns.

At the present time the prevailing size of letter paper is 8½ x 11 in., and this is one size which should be used for large catalogs. It is cut from 17 x 22 in. sheets without waste. For the smaller catalogs, 5½ x 8½ in. would be right, which is just one-half the size of the larger. These two sizes would be suitable for 95% of all catalogs. For the other 5% special sizes could be used, either larger or smaller. The 8½ x 11-in. catalogs should be loose leaf, allowing sheets to be removed without mutilation.

The same argument advanced for catalogs is applicable to letter heads, blank forms and reports. It is to be regretted that municipal, state and local governments, as well as the Federal, are great offenders in this respect. Many sizes, from the diminutive note to the absurd foolscap, are used indiscriminately. The latter size, introduced originally by lawyers, but now discarded by many of them, is still used by some engineers. For the sake of efficiency let us make the 8½ x 11-in. size our war standard.

Buffalo, N. Y. EMILE LOW.

International Technical Information Service Proposed

SIR.—The industrialists of this country are placing more and more dependence upon printed information, as witness the several hundred libraries operated by our leading industrial houses. The work of these libraries is extremely valuable, but the majority of them are working independently. This collective work would aid the industrialists of this country and our allies tremendously.

France, through the *Société de l'Encouragement pour l'Industrie Nationale*, is pushing a national organization for "technical literary reference to aid the industrialist in the 'economic struggle' after the war." Belgium and Switzerland already have valuable establishments for collecting and coördinating scientific information. London *Engineering* recently made a plea for the protection of both of these last mentioned institutions from the devastation of the Germans, and said that England should establish a similar bureau.

America has recently formed, under the National Research Council, a research information committee, the platform of which was outlined in *Metallurgical and Chemical Engineering*, April 1. In this committee is, or might be, the beginning of a "directional committee" for the coördination of the resources to be found in the libraries of the several hundred industrial and business houses of the country, to say nothing of the valuable material to be found in the department libraries at Washington, D. C., and in the technical collections

of the college, public and society libraries in this and the allied countries.

Believing that some sort of action is needed to follow up the excellent plea made by the editorial in *Engineering Record*, March 25, 1915, I have attempted to outline a few steps for the immediate organization of the "Association of Engineering Librarians" called for in that editorial.

(1) There should be appointed from the field of industrial libraries a committee on coördination and cooperation. (2) This committee should earnestly study the most profitable ways of linking together these several hundred technical libraries. (3) The central office of this committee might well be allied with the central office of this newly formed Research Information Committee, with a branch office in all leading cities of this country and of the allied nations. (4) This organization should receive government recognition, since our "close corporations" might not be willing to open their facilities or unite with other facilities except under Government recognition. (5) A certain amount of Government aid should be given the organization, as for example franking privileges in certain operations and free distribution of all of the Government publications likely to be of interest to this organization. (6) This "International Technical Affairs Information Service" should function, not only as a directional force in administering the resources of these several hundred technical libraries considered, but should also act as a large "mail order house" of technical information for the industrial houses not supporting technical libraries but which would pay a subscription to this organization for receiving practically the same benefits as would be received from their own special libraries.

Technical information is now being printed every minute. Every day lost in not harnessing this information through this proposed I.T.A.I.S. means so much economic loss to the many hundreds of technical men needing technical information as they never needed it before and as they will continue to need it after the war.

K. C. WALKER,
New York City. Librarian, New Jersey Zinc Co.

Aid to Solution of Hydraulic Problems

REVIEWED BY JOHN H. GREGORY
Consulting Engineer and Sanitary Expert, New York City

HANDBOOK OF HYDRAULICS: For the Solution of Hydraulic Problems—By Horace Williams King, M. Am. Soc. C. E., Professor of Hydraulic Engineering, University of Michigan. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Leather; 4 x 7 in.; pp. 424; illustrated. $3.

According to the author, this little handbook is intended primarily to assist in the solution of hydraulic problems. A knowledge of the fundamental principles of hydraulics is presupposed, hence the book will be much more useful to the practicing engineer than to the student.

The first chapter is devoted to a brief discussion of hydraulic units. Among the tables there is one, a conversion table, in which the arrangement is not only convenient but especially good. Hydrostatics are very briefly considered in the second chapter, which contains a number of useful tables. It is, perhaps, questionable whether tables giving the theoretical horsepower and kilowatts of 1 cu.ft. per sec. of water for heads from 0 to 100 ft. might not be better included under some other heading than in a chapter entitled "Hydrostatics."

After a chapter on orifices two long chapters are devoted to sharp crested weirs and weirs not sharp crested. Not only are standard formulas in use given, but the author includes also new weir formulas of his derivation which he states are simpler and conform to existing experimental data more consistently than other formulas.

The sixth chapter treats of the flow of water through pipes. Numerous formulas and tables are given. The author advocates the use of exponential formulas for pipes, and gives in detail a simplified method of using them. He does not recommend using the Kutter formula for pipes. A chapter is then devoted to the flow of water in open channels. It is interesting to note that the author departs from standard American practice in advocating the use of the Manning formula in place of the Kutter formula, on account of its greater simplicity. He states that he did not do this until he had been able to prove that the two formulas give practically identical results when the same coefficient is used.

The measurement of flowing water is taken up in the next chapter. Then follows a chapter on special problems, in which the use of the mass storage diagram is presented. It is perhaps questionable whether an explanation of the use of the common or Briggs logarithms might not be better included under some other heading than in a chapter entitled "Special Problems"—say in the final chapter, which immediately follows, and which is entitled "General Reference Tables" and includes tables of logarithms and cologarithms.

Two appendices are given to a comparison of weir formulas, with experiments, and to a comparison of the Kutter, Manning, and Bazin formulas with Scobey's experiments.

The text is well written and is very readable. One excellent feature which the author has adopted is the practice, when referring to a certain table, of giving also the page number on which the table will be found. Similarly, some of the tables are cross-referenced back to the text, by giving the page number of the text which relates to the table. This latter feature could to advantage be extended to tables in which no reference is made to the text, although some of the tables, from their general nature, might not need such a reference.

Throughout, references are given to publications and books so the user of the handbook may know the material from which the author has drawn. This is a feature to be commended. Some of the references give the date or year of publication, while in other cases, as for example the *Transactions* of the American Society of Civil Engineers, the volume number is given but not the year. The user is then at a loss to know whether or not the material referred to is of old or recent publication, a factor often of value. It is to be hoped that in a second edition the date of publication of each reference will be given—a slight addition, but one which many users would appreciate.

The hydraulic engineer who prefers to solve most of his every-day hydraulic problems by the laborious method of computations will find the handbook of great

assistance, as the tables, 112 in all, are complete and unusually well arranged. But the engineer who prefers to solve such problems simply and quickly by the use of diagrams—and, in general, results so obtained are good enough for a very large number of hydraulic problems—will find the handbook of but little assistance, as only two diagrams are presented. Both of these relate to the Manning formula, by means of which, when any three of the four quantities, hydraulic radius, slope, coefficient of roughness, and velocity, are known, the fourth may be found. In the writer's opinion the value of the book would be greatly increased by the addition of a number of well chosen diagrams, especially those giving the discharge of pipes.

It should be noted that some branches of the subject, which one might expect to find covered in a handbook of hydraulics, are not treated. Among these may be mentioned discharge under a dropping head, and the time of emptying and filling a vessel; the path taken by a jet when discharged from an orifice, and the energy of jets; and the form of the upper, as well as the lower, nappe of a sheet of water pressing over a sharp-crested weir.

Notwithstanding omissions, and despite the adverse criticisms made above, the book is, in the writer's opinion, one of the best that he has seen on the subject, as it contains a large fund of really valuable information, well presented.

Piping Comprehensively Treated

REVIEWED BY GEORGE A. ORROK

Consulting Engineer, New York City

A HANDBOOK ON PIPING—By Carl L. Svensen, B. S., Assistant Professor of Engineering Drawing in the Ohio State University, Junior Member of the American Society of Mechanical Engineers. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 352; illustrated. $3.

Professor Svenson has produced a text-book on piping which both in range of contents and in size greatly exceeds the three books on the subject previously available. (The earlier volumes, with the dates on which they were noticed in the Engineering Literature section of *Engineering News*, are as follows: "Steam Pipes: Their Design and Construction," by William H. Booth, devoted to British practice, June 15, 1905; "Pipes and Piping," by Hubert E. Collins, Dec. 17, 1908; "Steam Power Plant Piping Systems," by William L. Morris, Jan. 13, 1910.) Although the present volume appears to be a combination of lecture notes and material from manufacturers' catalogs and seems to show lack of knowledge of actual practice, yet within such limitations the work of preparation seems to have been well done, and as a text-book it will doubtless prove useful—though, of course, not as useful and as safe a guide for students as is desirable.

The first three chapters relate to the history of pipe and pipe threads and contain data as to the sizes and use of pipe. The next four chapters deal with fittings, joints and valves. Steam exhaust, water and gas systems are covered in Chapters VIII to XIV. To erection, insulating pipe covering, drawings and specifications is allotted a chapter each.

In general, the text and tables are very good and the illustrations well drawn. A few specific faults may be mentioned. Although the plates in the chapter on "Specifications" are valuable as examples of high-class engineering, the tables need to be corrected so as to cover the later work of the committee on pipe standards of the American Society of Mechanical Engineers. Going back to page 3, a serious error may be noted. Here the author advises the use of extra-heavy pipes for pressure above 125 lb. per square inch. He also says that standard pipes are sometimes used up to about 200 lb. per square inch, but that this is not advisable. As a matter of fact, full-weight pipe is in nearly universal use for pressures up to 225 lb. per square inch, while extra heavy pipe is rarely used except in small sizes or for special reasons.

It is unfortunate that the author does not use the term "Van Stone" as applied to pipe joints until he reaches Chapter VIII and then not again until Chapter XVIII, although he has illustrated the type, on p. 83, as the "Walmanco" and "Cranelap," both trade names for variations of the nearly universal Van Stone joint. The welded joint and nozzle (pp. 75-76) are somewhat cavalierly treated, although they have been known for 20 years at least and at the present are undergoing considerable change while their use is widening. The reviewer fails to find any mention of the use of the Van Stone joint with welded edges on high-pressure work (350 pounds).

Fig. 152 appears to be a violation of the American Society of Mechanical Engineers' boiler code (now the official standard of many states) in that a steam connection is made to the safety valve nozzle. Machine banded wood-stave pipe so common at the present time is not mentioned and continuous-stave wood pipe might well have received more space.

Some of these criticisms relate to what may be considered relatively minor points, but they will serve to illustrate opportunities for improvement in the next edition. It is to be hoped that when a revision is made the errors of omission and commission, which smack of the study and the classroom, rather than of the engineering office, the power house and the field, will be eliminated. The volume would then become more useful not only in the classroom but also in engineering practice.

Inspiration for City Planning

MODERN CIVIC ART, OR THE CITY MADE BEAUTIFUL—By Charles Mulford Robinson, Author of "Improvement of Towns and Cities." Fourth Edition. New York and London: G. P. Putnam's Sons. Cloth; 7 x 10 in.; pp. 375; illustrated. $3.50.

Prophet, apostle and practitioner of city planning in America, Professor Robinson made preparation shortly before his death for a fourth edition of this volume. The nature of the book was such that few changes were demanded for successive printings. Accordingly, the present edition differs little from the earlier ones. In fact, the changes appear to be confined to (1) slight cuttings of the plates here and there to correct an old or make a new statement of fact and (2) a preface for the present edition.

Since to many readers the volume offers itself as a new work, a general summary of its contents may be given. After the introduction, the four main divisions of the book, each containing a number of chapters, deal with local points, the business district, the residential sections, and the city at large.

Although it would be unfair to say that the book is inspirational rather than practical, emphasis may well be laid on its inspirational and esthetic appeal, and attention may be directed to the same author's more practical books, entitled "City Planning" and "Improvement of Towns and Cities."

Baker's Roads and Pavements, Revised

A TREATISE ON ROADS AND PAVEMENTS—By Ira Osborn Baker, C. E., D. Eng'g., Professor of Civil Engineering, University of Illinois. Third Edition. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 658; illustrated. $4.50.

So many engineers received their school training from the first and second editions of Ira O. Baker's "Roads and Pavements" that this third edition, revised and brought up to date and entirely rewritten, will find a place ready for it on their shelves. The new volume contains five chapters dealing with the more recent advances in paving practice, room for which was made by dropping an equal number of chapters which experience has shown to be of minor importance.

Particular attention is given to materials and those forms of construction that affect the quality and cost of the road and pavement, and less space is devoted to descriptions of machines and customary methods of doing work. Such changes make the book more useful for the designer and inspector than for the contractor. The work is, therefore, more engineering in its nature than the previous editions.

Using Garbage to Help Win War

GARBAGE UTILIZATION—With Particular Reference to Utilization by Feeding—Washington, D. C.: U. S. Food Administration. Paper; 6 x 9 in.; pp. 21.

FOOD CONSERVATION THROUGH UTILIZATION OF GARBAGE WASTE—By G. R. Bascom, in Charge of Municipal and Sanitary Engineering and Dr. B. A. Beach, Assistant Veterinarian, Agricultural Experiment Station. Madison, Wis.: The University of Wisconsin. Paper; 5 x 7 in.; pp. 11.

As an aid to winning the war the first of these pamphlets reviews the status of garbage disposal by feeding to hogs, reduction and burning in cities of 10,000 population and upward. Most of the space is given to the pros and cons of feeding to hogs, the methods of feeding and the value of pork produced. The second pamphlet follows somewhat the same lines as the first, but more briefly and simply, and with special regard to Wisconsin conditions. Each pamphlet deserves wide circulation and study among the classes for which it is intended.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these calums should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

AMERICAN CITY PROGRESS AND THE LAW—By Howard Lee McBain, Dorman B. Eaton Professor of Municipal Science and Administration in Columbia University. New York: Lemcke & Buechner. Cloth; 6 x 8 in.; pp. 260. $1.50.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION: Proceedings for 1917—Chicago, Ill.: The Association. Paper; 6 x 9 in.; pp. 261; illustrated. $1.

CHARTS FOR DESIGNING REINFORCED-CONCRETE BEAMS—By S. M. Cotten, Assistant Engineer, State Engineering Department, Phoenix, Ariz. Ten 8½ x 11 in. sheets for loose-leaf binder. Address the author. $2.

Blue prints of handy size giving net moments of resistance of reinforced-concrete beams distinctive in that the weight of the beam itself is taken care of in the curves.

THE COLUMBIA RIVER INTERSTATE BRIDGE: Final Report to the Commissioners of Multnomah County, Oregon, and Clarke County, Washington—By John Lyle Harrington and Ernest E. Howard, Consulting Engineers, Kansas City, Mo.: The Authors. Paper; 7 x 10 in.; pp. 61; illustrated.

Returning to a practice common a generation or more ago, the authors publish under the title "Final Report" a general account of a large bridge project. The Interstate bridge may be regarded as the largest steel highway structure on the Pacific Coast. Its numerous features of distinction in planning and construction and the concise, well written review make the pamphlet an interesting addition to technical literature.

THE DISTRIBUTION OF SOFTWOOD LUMBER IN THE MIDDLE WEST: Studies of the Lumber Industry—By Ovid M. Butler, Assistant Director, Forest Products Laboratory, United States Department of Agriculture; Part VIII, Wholesale Distribution; pp. 96; illustrated. Part IX, Retail Distribution; pp. 100. Washington, D. C.: Superintendent of Documents. Paper; 6 x 9 in.; illustrated. 15c. per copy.

ELEMENTS OF MACHINE DESIGN—By Henry L. Nachman, Associate Professor of Kinematics and Machine Design, Armour Institute of Technology, Chicago, Ill. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 235; illustrated. $2.

According to the preface, this book is intended primarily as a classroom textbook on the subject of elementary machine design. It is the result of the author's experience, extending over more than fifteen years, both in practical design and in teaching of this subject. The prerequisites on the part of the student are thorough courses in machine drawing and elementary mechanics. The volume contains a chapter on strength of materials, four chapters on fastening and 17 chapters on transmission machine parts.

EXPERIMENTS UPON THE PURIFICATION OF SEWAGE AND WATER: At the Lawrence Experiment Station, 1916—By H. W. Clark. Boston, Mass.: Department of Health. Paper; 6 x 9 in.; pp. 37.

THE JOURNAL OF THE IRON AND STEEL INSTITUTE—Edited by George C. Lloyd, Secretary. Vol. XCVI. New York: Spon & Chamberlain. London: E. & F. N. Spon. Paper; 6 x 9 in.; pp. 477; illustrated.

MASSACHUSETTS STATE DEPARTMENT OF HEALTH: Second Annual Report—Boston, Mass.: The Department. Cloth; 6 x 9 in.; pp. 553; illustrated.

THE MINING AND QUARRY INDUSTRY OF NEW YORK STATE—By D. H. Newland. Albany: The University of the State of New York. Paper; 6 x 9 in.; pp. 57.

THE MISSISSIPPI RIVER COMMISSION, REPORT OF—St. Louis, Mo.: The Commission. Paper; 6 x 9 in.; pp. 1835; illustrated.

NEW JERSEY SEWAGE WORKS ASSOCIATION: Proceedings 1918 Meeting—Frederick T. Parker, Secretary, Atlantic City, N. J. Paper; 6 x 9 in.; pp. 48.

THE PRINCIPLES, OPERATION AND PRODUCTS OF THE BLAST FURNACE—By J. E. Johnson, Jr., Consulting Engineer and Metallurgist. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 538; illustrated. $5.

Supplements the same author's volume on blast furnace construction, noted in Engineering News-Record, July 19, 1917.

PUBLIC HEALTH ADMINISTRATION IN RUSSIA IN 1917—By C.-E. A. Winslow, Professor of Public Health, Yale School of Medicine. Washington, D. C.: The Superintendent of Documents. Paper; 6 x 9 in.; pp. 31. 5 cents per copy.

RAILWAYS IN INDIA: Administration Report for the year 1916-17; Vol. I, pp. 39; Vol. II, Appendices, pp. 561. Simla, India: Secretary of the Railway Board. Paper; 8 x 12 in.; illustrated.

REGULATION OF RAILWAYS: Including a Discussion of Government Ownership Versus Government Control—By Samuel O. Dunn, Editor of The Railway Age; Author of "The American Transportation Question." New York: D. Appleton and Co. Cloth; 5 x 8 in.; pp. 333. $1.75.

ROADS AND PAVEMENTS: University of Texas Bulletin—Austin, Tex.: The University. Paper; 6 x 9 in.; pp. 48.

Contains papers on concrete and on bituminous roads and on road materials presented at a conference held at the University of Texas.

RULES FOR ESTIMATING: Standardization of Units and Methods for Measuring on Building Construction Work—Boston, Mass.: Building Trades Employers' Association of Boston. Paper; 4 x 7 in.; pp. 44. Paper, 25 cents per copy; cloth, 50 cents.

SAFEGUARD THE GATEWAYS OF ALASKA: Her Waterways—By E. Lester Jones, Superintendent, U. S. Coast and Geodetic Survey. Washington, D. C.: The Survey. Paper; 8 x 10 in.; pp. 41; illustrated.

SAND: Its Occurrence, Properties and Uses: A Bibliography—Pittsburgh, Penn.; Carnegie Library. Paper; 6 x 9 in.; pp. 72.

STRESS LINES IN BEAMS OF UNSYMMETRICAL CROSS SECTION—By C. M. Broomall. Media, Penn.: Delaware County Institute of Science. Paper; 6 x 9 in.; pp. 11; illustrated.

STRUCTURAL SERVICE BOOK, Vol. 1: A Revised Reprint from the Twelve Issues for 1917 of The Journal of the American Institute of Architects' Structural Service Department—D. Knickerbacker Boyd, Editor. Washington, D. C.: The Institute. Cloth; 9 x 12 in.; pp. 138. $3.50.

Gives references to literature and action of societies, companies etc., on various building matters. Like all such efforts, it lacks completeness.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

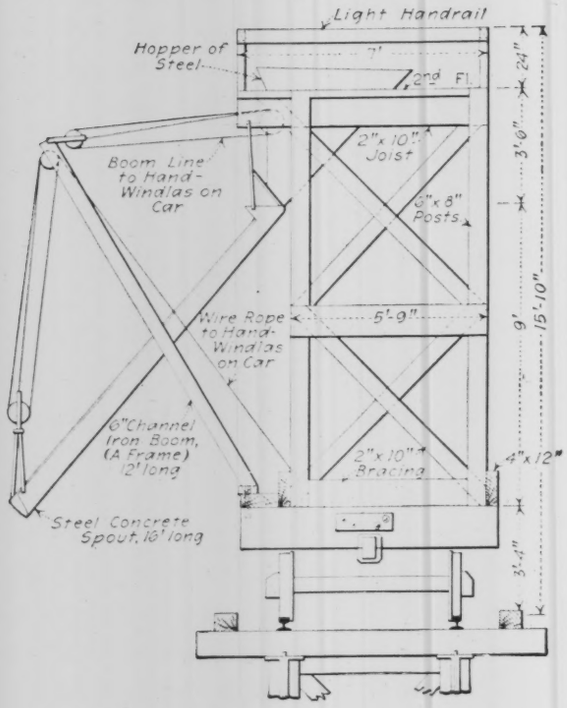
Horses Push Unusual Spreader to Level a Fill

AT A dump along the site of the now defunct "Bubbly Creek" at Chicago, the edge of the fill is leveled by a spreader made of an old wagon, and pushed by horses operating on the completed part of the fill. To the fore-carriage from a wagon was fastened under the tongue a timber of such length as to extend beyond the horses, and to the end of this in front of the horses, was braced transversely a plank panel, which forms the spreader. Behind the axle is a seat for the driver and also a rock filled box forming a counterweight. The horses are hitched to the pole between the wheels and the spreader, facing the latter.

New Bridge Concreted from Track of Parallel Old Bridge

THE hopper and spout car shown in the drawing, which will operate from an old railway bridge, 10 feet down stream, will concrete the floor of the new James River bridge at Richmond, Va. W. W. Boxley & Co., the firm which is building the bridge for the Richmond Terminal Co., expects by this means to solve a troublesome construction problem.

The new bridge is an eight-arch reinforced-concrete structure 2278 ft. long and 25 ft. wide, carrying a double track, and the floor level is about the same as the base of the rail on the old bridge, to which the new one is parallel. The concrete mixing plant will be located on the bank, and the concrete will be delivered at the spouting car in 3-yd. buckets, which will be dumped into the hopper by an industrial crane.



SPOUT CAR ON THE TRACK OF A STEEL BRIDGE CONCRETES A PARALLEL ARCH BRIDGE

The tower is built on the bed of a short flat-car which was turned over to the contractor for this purpose. It is made of 6 x 8-in. posts braced with 2 x 10-in. plank, and is fastened to the bed of the flat-car with long bolts which pass vertically through 4 x 12-in. plank bolted to its base. The tower is 5 ft. 9 in. wide, 10 ft. long, and 12½ ft high, and is set on the outside of the bed of the car, so that the weight of the hopper is carried directly over the rail nearest the work. A 3-yd. hopper is set in the floor of the elevated platform, which is surrounded with a light hand rail about 2 ft. high.

At one corner and on the inside edge nearest the work is a 12-ft. boom, made of 6-in. channel iron in the shape of an A-frame and hinged at its base on a pin fastened to the floor of the car. It is raised and lowered by a double block and tackle. A 12- or 16-ft. steel spout is fastened with one end under the hopper, and the other is hung from the end of the boom by a block and tackle. The falls from the boom and spout will be operated by a hand windlass on the car. It is planned to pour the floor slabs in place, and the car has been so designed that either by attaching an extra length of spout and lowering the boom, or by delivering concrete to a temporary hopper on the new structure, the entire area can be reached.

There is considerable freight transfer over the old bridge. When necessary the spout can be raised and swung over the car which is moved off the bridge to an adjacent siding.

Five-Ton Truck Loaded at One Dip By Railroad Shovel

FIVE-TON White trucks were loaded at one dip by a Bucyrus Type-C railroad steam shovel, on a rush contract to move 35,000 yards in 35 days. This is a new record for motor trucks, according to Bob Blake, who had the haulage contract.

The job was excavation for a factory site "somewhere in America," which the Walsh Construction Co. had promised to finish and which Bob Blake had contracted to haul at the rate of 1000 yd. a day. In spite of the fact that two days were lost through bad weather they finished the job about three hours ahead of time. Eleven trucks were used to run between the work and the dump, which was ½ mile away. About a quarter of a mile of the route to the dump was over dirt road, and a heavy drag and team were kept busy filling up the ruts. On the remainder of the road, which was water-bound macadam, piles of trap rock screenings were kept

at the sides of the road and holes were filled as soon as they developed.

Every facility for keeping the motor trucks going was on the job. In fact, a veritable field garage was maintained. The steel bodies on three of the motor trucks were demolished by the hard service, but they were quickly replaced and the average of 1000 yards a day was soon restored. Some of the trucks had their bodies enlarged so that they were capable of taking two shovelfuls at a load. About 30 to 35 seconds were consumed in loading the 5-yd. trucks.

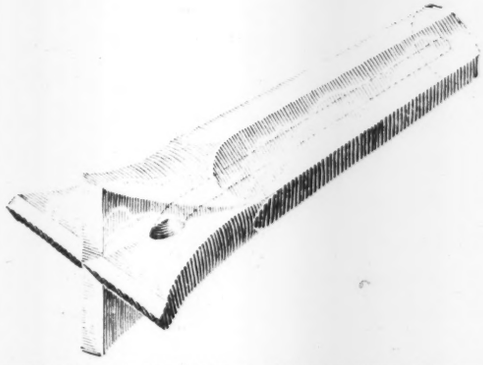
Out of the 9-hour workday, one hour was consumed in moving the shovel and another hour was lost on the road due to waiting on the movement of trains at a grade crossing.

Punch Hole Off Center to Prevent Hollow Drill Steel Clogging

By H. A. Sitterly

Chief Engineer, Low Moor Iron Company, Low Moor, Va.

Occasionally in using hollow drill steel, trouble is experienced because of clogging. Under these circumstances the benefits of hollow steel are entirely lost and the drill itself refuses to work. If the original



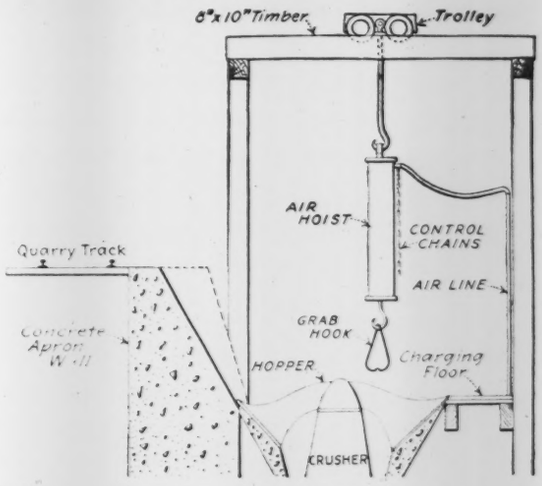
NEW HOLE PUNCHED A TRIFLE OFF CENTER

hole is closed and a new one punched in diagonally from a little off center, as illustrated in the accompanying drawing, no trouble will be experienced from clogging—in fact the drill will work better than before.

Air Hoist Removes Lodged Spalls From Crusher Bowl

A device which supplants the old crowbar and main strength method of freeing clogged crusher bowls is shown in the accompanying cut. Much loss of time and annoyance, it is said, are saved by it.

In one case where this method is used, the cars loaded with rock come in from the quarry on a track about 6 ft. above the charging floor. The stone from these cars is dumped into the hopper over a large concrete apron built for the purpose. Two 8 x 10-in. timbers on edge, secured to the frame of the building, carry a four-wheeled dolly truck over the center of the hopper. Suspended from the truck by a hooked bar is a medium-sized cylinder air hoist fitted with the usual air con-



HOIST FOR SPALLS SAVES DELAY AT CRUSHER

trol chains, and connected to a convenient air line. A set of grab hooks designed for the handling of large irregular pieces of rock is attached to the hook end of the piston.

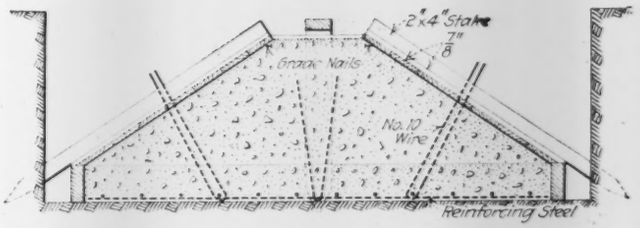
Under ordinary running conditions the air hoist and the trolley are easily pushed to one side, but when a large spall lodges between the supporting bridge and the sides of the hopper, or when it is necessary to raise a large piece of rock clear of the hopper, the hoist is swung out and the spall is removed without loss of time.

Forms for Pyramid Footings Anchored to Reinforcing

By John T. Sullivan

Roos Bros. Construction Co., Cincinnati, Ohio

Side forms on pyramidal footings, where the pressure might lift up the side slabs, may be held down by anchoring them to the reinforcing steel in the bottom of the form. The writer has seen cross-ties, stone or any other weight that was handy piled on forms of this character to keep them from lifting, but has found



WEIGHT OF CONCRETE ON BOTTOM REINFORCING HOLDS FORMS AGAINST UPLIFT

it better to drive sloping stakes into the sides of the footing excavation as close to the form as possible, wedge the form to the sticks and wire the stakes down to the reinforcing in the bottom. A considerable weight of concrete is on this reinforcing before any pressure comes on the side forms, and the anchorage thus provided is sufficient to prevent displacement of the forms.

NEWS OF THE WEEK

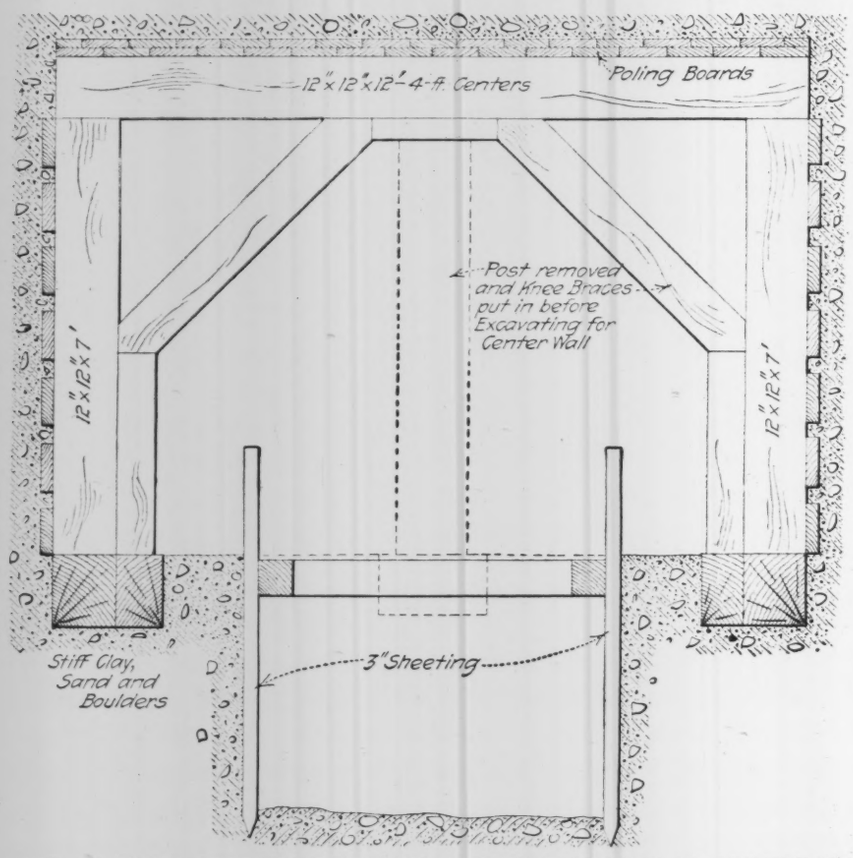
CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

New York Subway Cave-In Kills Three

Slipping of Post in Timbering of Top Heading Perhaps Caused by Undermining

The cave-in in the new Flatbush Ave. subway in Brooklyn, N. Y., on the night of May 8, just south of the Prospect Park Plaza, is thought to have been due to the settling of a post on the east side of the top heading, in the bench of which a trench was being excavated for the center wall.

The subway in this section is a double-track concrete structure with a center wall and two arches. The structure at the point where the accident occurred is being built by driving a top heading along the line of the center wall, excavating a trench in the heading to the bottom of the center wall, then concreting the wall and the umbrella, and coming along later with the outside walls of the final arch. Work had been shut down since last November on this particular heading, which was at the time about 300 ft. north of shaft No. 3 in Flatbush Ave. The concrete structure had been completed to the end of the previous excavation, and the top heading for the center wall had been driven about 50 ft. further. The first operation on resuming work was to excavate the trench in the bottom of this heading to extend the center wall. This trench, which is sheeted and braced as excavated, had been carried down about 7 ft. at the end of the previous concrete and tapered from that to nothing about 25 ft. up the heading. The sheeting had all been placed nearly to the post that first settled, and the top set of bracing put in for the entire length of the excavation. Conditions found after the accident indicated that the foreman and two men were placing the sheeting in front of this post at the time of the collapse.



POST AT RIGHT SETTLED, BREAKING CAP OVER LEFT-HAND KNEEBRACE

The soil through which the tunnel is being driven, though subgrade, is about 85 ft. below the street level, is very dry and contains no running sand. In places it has almost the character of hardpan, being composed of clay, sand and boulders thoroughly mixed and without pockets. In places in the heading where the accident occurred it has stood up for months without any boards between the timber sets. It is suggested that the very excellence of the ground may have caused some carelessness in handling the sheeting.

The timber sets rest on 12 x 12-in. blocking, two end posts and a center post being used in taking out the heading. When the trench excavation begins kneebraces are put in and the center post is removed. The trench sheeting is about 3 ft. from the inner sides of the outside posts.

At the time of the accident one of the workmen said that a post on the east side of the tunnel had begun to settle, apparently having been undermined in some way in the starting of the trench excavation. The three men who were killed, were, according to this statement, attempting to brace the post when it collapsed. Settlement of this post, as shown by the position of the timbers when uncovered broke its cap over the opposite kneebrace. This set and the next one north of it then gave way, letting in a mass of material which blocked the tunnel for about 20 ft., buried the foreman and two of the workmen and imprisoned the other eight men in the crew in the heading. The electric light wires, however, were not broken, and the eight men were taken out uninjured in about seven hours after an air pipe had been driven through the dirt to them and a small heading 20 feet long had been carried through the top of the slide by the poling board method.

The cave extended clear to the street surface, where it showed beneath the car tracks. It was necessary to carry them with I-beams across the hole formed and to deck a section of the street about 20 ft. square.

There is no evidence of the timbers having broken prior to the collapse. The bents which failed are the fourth and fifth in order from the end of the concrete previously placed, the east post of the fourth bent having been the one to settle. The sixth bent was severely strained and the cap timber sagged 3 in., but the bent held. The caps in this section are about 4 ft. between centers, and it is stated that in none of the other headings driven by this method has the timber shown any signs of carrying a heavy load.

The work of removing the débris had proceeded so far by May 14 that all the bodies had been recovered, the original top heading had been cleared out, the two missing sets had been replaced and work resumed. The work, which is done by the Degnon Contracting Co., under direction of the Public Service Commission, First District, will be carried forward by the same methods.

Highways in Wartime Discussed by Canadian Road Congress

The Fifth Canadian Good Roads Congress was held at the Royal Connaught Hotel, Hamilton, Ont., May 7-10, with a large number of delegates, including many from the United States, in attendance. The chair was occupied by Capt. J. A. Duchastel de Montrouge, of Outremont, Que., president of the Canadian Good Roads Assn. Mayor Booker, of Hamilton, delivered an address of welcome. Other speeches of welcome were made by S. L. Squires, Toronto, representing the Canadian Good Roads Assn.; T. R. Kelly, on behalf of the Hamilton Board of Trade, and L. B. Howland, president of the Canadian Automobile Association.

W. A. McLean, Deputy Minister of Highways of Ontario, and B. Michaud, deputy minister of highways for Quebec, delivered addresses. James H. McDonald, ex-state highway commissioner of Connecticut, spoke briefly, voicing the determination of the American people to prosecute the war.

The principal feature of the second day's proceedings was an address of a highly practical character by Col William D. Sohier, chairman of the Massachusetts Highway Commission, who emphasized the point that the highways must be built strong enough for motor trucks. Lieut. Col. W. G. McKendrick, D. S. O., who had been director of roads for the Fifth British Army, told of his work in roadmaking in Flanders. Arthur H. Blanchard, consulting highway engineer of New York City, described English and American practice in the construction of tar surfaces and pavements. F. Howard Annis, of Whitby, Ont., urged the necessity of building wider roads.

The question, "Who Should Pay for the Road?" was dealt with by W. A. McLean, who said that to have a complete good roads system the cities and towns should pay equally with the countries. At a wartime repast in the evening the principal speakers were James H. McDonald, Col. Sohier, B. Michaud, L. B. Howland and R. T. Kelley. At the morning session on May 8, James H. McDonald spoke on "Drainage," expressing a preference for the English and Scotch rubble drainage, as compared with the high crown-center highway. L. B. Howland outlined certain legislation which he considered necessary for the regulation of traffic on highways. A. Lalonde, C. E., assistant engineer of Outremont, Que., spoke on the "Characteristics of a Good Road."

The annual meeting of the Canadian Good Roads Association was held in the evening when the following officers were elected: Honorable President, Capt. Du Chastel de Montrouge, Outremont, Que.; President, S. L. Squire, Toronto; Secretary-Treasurer, G. A. Manamee, Montreal.

At the final session of the Congress several addresses on technical subjects were delivered, including a paper by C. A. Mullen, director of the paving department of the Milton L. Hersey Co., Montreal, and one by E. R. Gray, city engineer of Hamilton, on the "Abatement of the Dust Nuisance."

It was decided to hold the next convention at Quebec. An interesting feature of the convention was an exhibition of road-making machinery.

War Spirit Marks Convention of Water-Works Men

Meet in St. Louis To Discuss Part To Be Taken for Victory, and Other Timely Topics

Intense war spirit and an unexpectedly large attendance marked the opening of the 38th annual convention of the American Water-Works Assn. at St. Louis, May 13-18. More than four hundred members, with two hundred guests, had registered when the convention began its sessions on Tuesday evening.

In the address of welcome by Mayor Keil, as in all the proceedings, formal and informal, stress was laid on the important part the association and its members could play in the winning of the war, especially through the preservation of the health and efficiency of the nation's fighting forces and the civilian population.

All four of the proposed amendments to the constitution of the association were adopted. New officers for the ensuing year are: Charles R. Henderson, manager of the Davenport Water Co., Davenport, Iowa, elected president; Carleton E. Davis, chief of the Bureau of Water, Philadelphia, vice-president.

The efforts of the American Water-Works Manufacturers' Association to make a showing were rewarded with much favorable comment, especially marked at the handsomely decorated booths at headquarters.

The social side of the convention came in for a large share of attention on the afternoon of Tuesday, the opening day, the center of attraction being a golf tournament. Wednesday afternoon the boat ride to the filtration works claimed the time of many of the members. Thursday will be "Superintendents' Day" and will bring out a large number of features of especial interest to the managers of water-works.

The Minnesota section has won the cup offered for the largest percentage of gain in membership in the year 1917-18.

City Planning Conference Will Be Held in St. Louis

War housing and lessons from the planning of the army cantonments are among the subjects to be considered at the tenth National Conference on City Planning, to be held at the Statler Hotel, St. Louis, Mo., May 27-29. Other subjects for papers and discussion include the zoning system in practice, as applied to industrial and residence districts; city planning in the allied countries during the war; an industrial survey of St. Louis and the St. Louis city plan.

A special feature of the conference will be breakfast meetings, when each specialist will preside over a small group in order to answer questions and give advice informally.

The officers of the conference are Frederick Law Olmsted, Brookline, Mass., president, and Flavel Shurtleff, Boston, secretary.

New York State Will Authorize Niagara Power Development

Governor Whitman of New York has signed the Thompson bills authorizing the merger of three Niagara Falls power companies, and permitting them to use diverted water from the Niagara River to generate additional power needed for war purposes. These bills were introduced at the request of the War Department, and were passed and signed over vigorous protests from city officials of Buffalo.

The measures were opposed because it was believed that when the consolidation was effected it would result in increased rates, at the same time abrogating the powers of the Public Service Commission. On account of this opposition, the Governor insisted before he signed the bills that representatives of the companies concerned sign a statement that the bills are approved as war measures for the purpose of saving time in the development of power needed by the Federal Government. The statement also declared that the consolidated companies would never claim before any ratemaking body that the capitalization authorized by the bills is to control rates. The companies further agreed that they are entirely under the control of the Public Service Commission.

Germany Forms Organization for Promoting War Science

It is reported that the German government has approved the formation of an organization to be known as the "Kaiser Wilhelm Trust for the Promotion of War Science." The aim of the trust is the furtherance of the development of scientific and technical aids to warfare, by coördinating the work of the scientific and military forces. According to the report, it is planned to have the scientific work carried on by the following technical committees: For chemical raw materials; for the production of munitions manufacturing materials; for war materials (powder, explosives, gas, etc.); for physics, including ballistics, telephony, telegraphy, determination of target distances, measurements, etc.; for engineering and communication; for aeronautics; and for the procurement and preparation of metals.

War Department Authorizes Construction of Gun Plant

The War Department has arranged with the United States Steel Corporation for the construction and equipment, for the Government, of a modern ordnance plant on Neville Island, in the Ohio River, near Pittsburgh. A committee composed of officers of the corporation and the subsidiary companies will be in immediate charge of the work, without compensation.

The plant is to be built, equipped and operated without profit by the steel corporation. Cannon of the largest calibers will be manufactured, as well as heavy projectiles in large quantities. It is said that the plant will be the largest in the world, surpassing in size the Krupp works, and the cost of building will be $50,000,000, or more.

Neville Island is seven miles long and not more than a mile wide. At one end is the Neville furnace of the Carnegie Steel Co., a subsidiary of the United States Steel Corporation. Railroads occupy each bank of the river, paralleling the island, the New York Central R.R. on one side and the Pennsylvania R.R. on the other.

Navy Desires Steam, Electrical and Radio Engineers

Trained engineers for general service in the Navy in steam engineering, electrical engineering and radio duties are desired by the Bureau of Navigation of the Navy Department. Applicants if accepted will be enrolled as ensigns in the Naval Reserve Force and sent to the reserve officers' school at Annapolis for a special course of about four months, after which those who finish the course successfully will be placed in further training ashore or afloat, and then become available for regular sea or shore duty.

Applicants should have a degree in mechanical, electrical or mining engineering, should have had at least 2½ years' engineering experience after graduation (not as sales agents) and should be physically strong and sound in health and not more than 35 years old.

The American Institute of Electrical Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the Naval Consulting Board and the National Research Council have each been requested to submit a list of 50 names equally proportioned among those of men trained in the three lines of duties mentioned in the first sentence above, but the exact duties to be performed in service will be determined after the completion of the course. The Engineering Council, 29 West 39th St., New York, is acting for the five organizations named. Each applicant should send promptly a résumé of his education and engineering experience, and a small photograph and letters of recommendation if possible. A class at Annapolis will probably be formed about June 15.

Building of Wooden Ships Is Increasing Fast

One Atlantic Yard Has Launched Two Vessels—Pacific Coast Firm Has Put Thirteen Into Water

Records of the Emergency Fleet Corporation show that the contractors in shipyards engaged in producing wooden merchant vessels have launched a total of 168,500 tons in the 5½ months since Dec. 1, when the first of its wooden vessels took the water on the Pacific coast. A large progressive increase each month in the number of vessels launched and in the number of producing yards is shown by the figures. Only two hulls with a total capacity of 7500 tons were launched in December, and none was completed in January. In February, however, five hulls, with a capacity of 18,500 tons, took the water, while 11, amounting to 45,500 tons, were produced in March; 17 with a capacity of 60,500 tons in April, and 11 of 39,500 tons in the first 12 days of May. There are now 21 firms which have launched at least one ship apiece, 15 of them with a total of 39 vessels to their credit being on the Pacific coast, three which have launched one ship apiece on the Gulf coast, one on the Great Lakes which has launched one hull, and two on the Atlantic coast which have each produced three vessels.

One of these vessels, the second to be launched on the Atlantic coast, and the second hull completed at the yard of the Foundation Co., Newark, N. J., is shown on the front cover of this issue, while the third vessel was launched by the Portland Shipbuilding Co., Portland, Me., on May 8.

One firm on the Pacific coast, the Grant-Smith-Porter Co., at Aberdeen, Wash., launched 13 hulls between Feb. 24 and May 12. Two other firms have launched four apiece, while three have launched three apiece. A total of 46 vessels constructed under the wood shipbuilding program of the Emergency Fleet Corporation had been put in the water by May 12.

Contracts for Mississippi Steel Barges Let

Eighteen To Be Built for Federal Government at Unit Cost of About $90,000.

Steel barges are to be built with Government funds for operation on the Mississippi River. Contracts for 18 of the vessels have just been let to three different firms by the United States office at St. Louis, which designed the barges for the inland waterways committee of the railroad administration. A fund of $3,600,000 was diverted from the Shipping Board for the purpose some months ago.

The barges are to be 300 ft. long with 48 ft. beam and 10 ft. total depth. They are designed for freight capacity increasing from 570 tons on 3 ft. draft up to 2600 tons on 8 ft. draft. Displacement is 1420 tons and weight of steel and fittings 460 tons. Oil will be carried in the compartments below deck. The cargo hopper, depressed 5 ft. from the outside framing, is 36 x 256 ft. in plan. It is intended that the barges be towed.

Bids were received on 24 barges from six firms, all quoting on construction exclusive of the cost of steel, which is to be furnished by the Government. Three of the bids were considered excessive, ranging from $89,000 to $123,000 per barge. The successful bidders, each of whom got six barges, were the Dravo Construction Co., Pittsburgh, $64,000; Dubuque Boat and Boiler Co., Dubuque, Iowa, $65,000; Marietta Manufacturing Co., Point Pleasant, W. Va., $64,959. The barges contain 285 tons of plates, which the Government estimates at 3¼c., and 135 tons of shapes, at 3c., so that the total cost with steel will be about $92,000 per barge. Deliveries will not be made until June, 1919.

Administrator of War Labor Activities Appointed

The Secretary of Labor has appointed Felix Frankfurter, of Harvard University, as administrator of war labor activities. The creation of the office is designed to bring under central control the labor activities of all Government departments dealing with the production of war materials. Mr. Frankfurter will coördinate the industrial sections of the War and Navy Departments, the Shipping Board, the Department of Agriculture and the War Industries Board. Heretofore all of these departments have acted independently in obtaining their labor supplies and in making wage awards.

Mr. Frankfurter has been serving as assistant to the Secretary of War. He recently returned from England and France, where he studied war labor activities. He said that the new office would work for uninterrupted maximum production.

"Steps will at once be taken by the Government as employer, through whatever department it may be operating, toward uniformity of treatment so as to secure stability of conditions and therefore the needed production," he said. "I shall have the benefit of the experience and support of the able industrial services of the different departments of the Government. All are agreed on the end to be attained—maximum production under the fairest conditions—which alone will insure the quickest winning of the war."

Cities Co-operate in Work of Capital Issues Committee

The Capital Issues Committee announced May 12 that the number of applications considered during the week just passed was greater than in any previous week of its existence. The

committee determined 37 cases, aggregating $27,487,277.56, of which $4,811,000 were disapproved. In addition to the amount formally disapproved, postponement for the period of the war was secured informally of issues aggregating $4,990,000. The $22,676,277.56 approved included $6,777,084 of refunding obligations, so that the new issues approved aggregated $15,899,193.56. New issues for the corresponding period last year amounted to $14,196,500.

The committee stated that spread of the knowledge of its aims and purposes continued to be reflected in voluntary postponement of security issues, a case being cited in the City of St. Louis, Mo., which has adopted a policy of financial preparedness consistent with the national welfare. The city has notified the committee that it is going ahead with securing local authority to create certain debts and advertising the issues of bonds therefor, so that they may be marketed readily at the proper time, but that it will submit for approval by the committee only such issues as are for urgent and essential purposes. The city is at present advertising about $14,000,000 of bonds which it does not propose to market until the conclusion of the war. Other municipalities in Federal Reserve District No. 8 are adopting the same patriotic course. The Milwaukee member of the subcommittee of the Minneapolis Federal Reserve District reports that the city of Milwaukee, in bringing its needs into conformity with the national interests, has reduced presently contemplated bond issues from $5,740,000 to $1,050,000.

Washington Garbage May be Fed to Pigs, Livestock or Poultry

Authority to buy or lease the plants used by the Washington Fertilizer Co. for the collection, removal and reduction of garbage, and by M. R. Ready for collection and disposal of municipal refuse, has been given to the Commissioners of the District of Columbia by a Congressional act signed by the President, May 6. If prices cannot be agree on, the Commission may take the plants at once, the price to be determined by appraisers appointed by the Attorney General, with right of appeal to the District Court and on up to the United States Supreme Court.

Feeding the District garbage to "pigs, livestock or poultry" on District institution land or on land bought or leased for the purpose is authorized; or the garbage may be temporarily disposed of by burial. The purchase of collection equipment, either horse-drawn or motor, is also authorized. A total of $620,000 may be spent to carry out the provisions of the act, under the following limitations:

(1) Purchase of garbage plant, not more than $85,000; (2) refuse plant, $50,000; pigs, livestock and poultry, $200,000.

School Established at Stevens for Navy Officers

A school to be known as the United States Navy Steam Engineering School has been established at Stevens Institute of Technology, Hoboken, N. J., under the guidance of Dean F. L. Pryor, civilian director. Its purpose is the training of considerable numbers of naval engineering officers.

The course consists of five months' training, divided as follows: One month of military training at the Naval Training Camp, Pelham Bay Park, New York; one month at the U. S. Navy Steam Engineering School; two months' practical training on board ships and in repair shops in the vicinity of New York, and one month finishing course at the U. S. Navy Steam Engineering School.

The school is open to men between 21 and 30, who are physically qualified, of thorough ability and officer-like character, and who have completed the engineering course at any recognized technical school.

The announcement states that the school presents particularly desirable opportunities to the young technical man, both in affording him a proper outlet for his trained faculties during the war, and in rounding out his college work with a practical course and school experience which will be of value to any engineer. The service that a graduate from the school will perform will be that of an engineer-officer in the auxiliary service of the Navy. A graduate of the school will be commissioned an ensign in the U. S. Naval Reserve Force.

Any men, graduates or undergraduates, who are registered in the draft can enroll with the proper enrolling officer by securing from the draft board letters of release, which in all probability, it is stated, can be obtained for this purpose, provided the men are not included in the current draft quota.

Special provision has been made for the continuance of the school with proper material by a Navy regulation which permits undergraduates of the freshman, sophomore and junior classes in recognized engineering schools to enroll in the Navy with a rating of seaman, second class, and continue their courses at the institutions where they have matriculated. Such men will be called into active service after their graduation and can at that time, if physically qualified to pass an officer's physical examination, enroll for the course at the U. S. Navy Steam Engineering School.

Information has been sent to all registered technical schools and should be on file at the president's office. For any additional details application can be made to the Civilian Director, U. S. Navy Engineering School, Stevens Institute, Hoboken, N. J.

War Aspects of Fire Protection Discussed at Chicago

Greater attention needed by fire prevention and fire protection at army camps and munition factories was emphasized in a statement made by W. H. Merrill at the annual convention of the National Fire Protection Assn., held at Chicago May 7-9. Mr. Merrill, who is president of the Underwriters' Laboratories and chairman of the fire prevention section of the War Industries Board, said that in many cases such emergency plants have been built with little consideration for fire hazard, although their destruction might seriously affect the program for output of munitions. On the other hand, owing to good equipment and systematic watching systems at camps, munition factories, shipbuilding yards, etc., the fire losses during the construction period were unprecedentedly low.

Emergency housing, fire protection for cantonments and war-emergency buildings of wood construction to meet the situation existing in many industrial centers and army cantonments

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June	4.17	Sept.	4.20	Dec.	4.23

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were the subject of recommendations prepared by the committee on fire-resistant construction. Specifications for standard fire tests were presented by the committee.

Elmer C. Jensen, director of the American Institute of Architecture, and Sidney J. Williams, engineer of the Wisconsin Industrial Commission, discussed fire protection and building-code requirements in regard to hotels and apartment houses. Classification of industrial buildings according to the number of occupants as determined by stair capacity was reported on by the committee on safety to life.

Officers elected for the association for the next year are as follows: President, F. J. T. Stewart, New York; vice presidents, H. O. Lacount, Boston, and W. E. Mallalieu, New York; chairman of the executive committee, H. L. Phillips, Hartford, Conn.; secretary and treasurer, Franklin H. Wentworth, Boston.

Indiana Lower Court Holds State Highway Law Invalid

The new state highway commission law of Indiana, passed by the last legislature, has been declared unconstitutional by Judge Cloe of the Hamilton County Circuit Court.

The action was taken in overruling a demurrer filed by the state, against a suit questioning the validity of the law. The ruling will stop work only on the Range Line highway in Hamilton County, but in the face of this decision it is reasonably certain that no work will be done on other state routes until the higher courts decide on the constitutionality of the law. This is considered unfortunate, in view of the very large amount of work planned for the next two years by the commission.

New York State Barge Canal Is Completed for Navigation

The New York State Barge Canal was made navigable May 10 for its entire length by the removal of the earth wall that separated the canal from the Genesee River in Genesee Valley Park at Rochester.

State Engineer Frank M. Williams, his deputy, the division engineer for the western division, and assistants were present, and the first water from the river was admitted to the canal by the state engineer. Although much work remains to be done before the canal is completed, it is now navigable from end to end. With the final work on the canal being completed at Rochester, it was noted by state officials that the first work was done just west of Rochester in May, 1905.

Board Censures Local Associations for Stand on Profit Tax

The Board of Direction of the American Society of Civil Engineers passed the resolution printed below Apr. 16, after receiving protests from the associations of members of the society in Utah, Colorado, and the Northwest against resolutions passed by the board on Nov. 1 last, which called for a repeal of the excess profit tax as applied to the incomes of engineers;

"Resolved, that while disclaiming any desire to control individual opinion or its expression, or any protest of local associations of the Society, made to the board against any of its acts, the Board of Direction disapproves and condemns the action of the Utah, Colorado and Northwestern local associations in making public their official action which protested against the action of this board."

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York; Spring meeting, June 4-7, Worcester, Mass.

NATIONAL MUNICIPAL LEAGUE; 703 North American Building, Philadelphia; June 4-6, New York City.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS; 129 York St., Brooklyn, N. Y.; June 19-22, Berlin, N. H.

AMERICAN CONCRETE INSTITUTE; 27 School St., Boston; June 27-29, Atlantic City, N. J.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 25-28, Atlantic City, N. J.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS; 29 West 39th St., New York; June 26-28, Atlantic City, N. J.

The American Society of Mechanical Engineers will hold its annual spring meeting this year at Worcester, Mass., June 4-7. On the first evening at the Hotel Bancroft there will be a meeting of welcome, followed by a reception and dance; June 5 will be "New England Day" and the morning meeting will be held at the Worcester Polytechnic Institute, the afternoon and evening sessions at the Hotel Bancroft. In the morning various industries and their relations to the war will be discussed; in the afternoon there will be a general session and an industrial safety and workmen's compensation session. The evening will be devoted mainly to a discussion of "How the Engineering Societies Can Assist in the Procurement Program of the Government." Thursday will be given up to general, fuel and public relations sessions, with an inspection of the Norton Co.'s community housing and garden projects in the afternoon, and a dinner and illustrated lecture in the evening. On June 7 there will be an automobile trip to Camp Devens, Ayer, Mass., in the morning, and also a trip to Concord and Lexington in the afternoon.

The Duluth Association of Members of the American Society of Civil Engineers will hold a joint dinner and meeting, on the evening of May 20, to which engineers in all branches of the profession in the Duluth region are invited. The meeting will be addressed by Calvin W. Rice, national secretary of the American Society of Mechanical Engineers. Richard Khuen, Jr., of the American Bridge Co., Pittsburgh, will give an illustrated talk on the erection of the Hell Gate bridge at New York City. Kirby L. Strickland, Chicago, will present a paper on the erection of the Union Pacific bridge over the Missouri River at Omaha, illustrated by pictures taken during the erection. John R. Allen, dean of the College of Engineering, University of Minnesota, will also address the meeting. Following the program there will be a general discussion of matters pertaining to the engineering profession in the Duluth region.

The Civil Engineers' Society of St. Paul has elected the following officers: President, A. F. Meyer; vice president, E. S. Spencer; secretary, Paul C. Gauger; treasurer, E. O. Korsmo.

N. J. Whelan, industrial commissioner of the Wisconsin-Minnesota Light & Power Co. at Eau Claire, and V. S. Hillyer, construction engineer of that company, spoke before **The Engineers' Society of Milwaukee**, May 8 on the construction of Wissota dam. Moving pictures were taken while the dam was in course of construction, and the most important reels were shown on the screen.

The Nebraska Association of Civil Engineers held a meeting May 4 at Grand Island during the trip to inspect the new bridge of the Chicago, Burlington & Quincy R.R. Co. at that place. A number of visiting engineers from other railroads and various parts of the country were at the bridge during the day to inspect the new plan of constructing river piers by the use of the Bignell jet piling.

The Harvard Engineering Society of New York will hold its annual field day May 25 at the Short Hills Club, Short Hills, N. J.

The Colorado Association of Members of the American Society of Civil Engineers, at its meeting on May 11, was addressed by Charles W. Comstock, Z. E. Sevison, state highway engineer of Wyoming, and J. A. Maloney, secretary of the Colorado State Highway Commission, on highways and highway engineering.

On May 18 there will be a joint technical session of **the Pittsburgh and Cleveland District Sections of the Association of Iron and Steel Electrical Engineers** at Youngstown, Ohio. The feature of the session will be a visit of inspection to the McDonald and Ohio works of the Carnegie Steel Company.

The New York Chapter of the American Association of Engineers will hold its annual election of officers at the Hotel McAlpin, New York City, on the evening of May 22. G. A. Harris, chief

engineer, American Steel Export Co., will speak on "Opportunities for the American Engineer in the Export Field."

The Louisiana Engineering Society was addressed May 13 by T. F. Carlisle, British consul in New Orleans, on "Britain and the War — The Last Twelve Months."

PERSONAL NOTES

J. P. J. WILLIAMS, for the past year first assistant engineer with the Concrete Steel Engineering Co. of New York City, and formerly associate editor of *Engineering Record*, has returned to the publishing field as assistant to the vice-president of the McGraw-Hill Co., Inc. Mr. Williams was graduated from the University of Pennsylvania in 1898, and subsequently received the degrees of master of science and civil engineer from the same institution, where he served for two years as instructor in engineering after graduation. Of the 14 years which then elapsed before he joined the staff of *Engineering Record* in 1915, seven were devoted to teaching structural engineering at Swarthmore College, Columbia University, the University of California and the University of Minnesota. The other seven years were spent in drafting and design work with the Pennsylvania Steel Co., the Southern Pacific Co., the Baltimore Bridge Co., the Baltimore & Ohio R.R. and the McClintic-Marshall Construction Co. Mr. Williams is the author of several articles in *Engineering News* and *Engineering Record* and of discussions before the American Society of Civil Engineers.

GEORGE H. FENKEL has resigned as commissioner of public works, Detroit, to become civil engineer to the Water-Works Bureau.

J. M. OATES, superintendent of the Atlantic Bitulithic Co., until recently in charge of the military highway being built by the city of Newport News, connecting Government embarkation camps, has been transferred to the naval operating base, Norfolk, Va.

C. E. SMITH, city consulting engineer, St. Louis, has received a commission as major in the construction division of the army, and has resigned his position with the city.

BENJAMIN L. SMITH was engaged by the American International Shipbuilding Corporation as engineer of utilities and not as assistant to the engineer of utilities as stated in *Engineering News-Record* of May 2, p. 885.

HARRY ARTHUR HOPF, consulting industrial engineer, has established offices at 55 Liberty St., New York City.

D. HUBBARD has been appointed division engineer of the Baltimore & Ohio R.R., at Newark, Ohio, succeeding C. R. Diermar, transferred.

D. ROUNSEVILLE, engineer maintenance of way, Chicago North Western Ry., Chicago, has been appointed assistant to the chief engineer. The office of engineer maintenance of way has been discontinued.

W. H. PENFIELD, assistant to the vice-president, Chicago, Milwaukee & St. Paul Ry., Chicago, has become engineer of track maintenance, with headquarters at Chicago.

A. J. MITZEL, assistant engineer, Hocking Valley Ry., is now associated with the American Steel & Wire Co., Cleveland.

H. L. ARCHBOLD has become division engineer of the Southern Pacific Co. at Tucson, Ariz. Mr. Archbold succeeds J. D. Mathews, resigned.

H. J. HANLIN has become sanitary engineer of the St. Louis-Southwestern lines, with offices at Texarkana, Ark. Mr. Hanlin succeeds H. W. Van Hovenberg, who has become sanitary engineer for the United States Public Health Service.

H. C. PHILLIPS, general secretary of the Presidents' Conference Committee of the railroads, has resigned to become chairman of the Western group of the Engineering Committee at Chicago. Mr. Phillips, formerly chief engineer of the Coast lines of the Santa Fé system, and later valuation engineer for the system, left the latter position in 1915 to become assistant general secretary of the Presidents' Conference Committee. He was made general secretary in 1917.

B. M. HALL has been appointed to the municipal board of consulting engineers, Atlanta, Ga. Mr. Hall succeeds G. R. Solomon, who has received a commission in the Engineer Corps.

MCLEAN LONG, consulting engineer, New York City, has removed his office to 120 Broadway.

W. JESS BROWN has become district engineer of the Portland Cement Assn., in charge of the Atlanta office. Mr. Brown succeeds C. N. Wiley, who resigned to reënter the service of the Standard Portland Cement Co. at its Leeds (Ala.) plant. Mr. Brown has been with the Portland Cement Assn. for a number of years.

G. C. HARDING has become chief draftsman for the Federal Bridge & Structural Co., Waukesha, Wis. Until recently Mr. Harding was engaged in the supervision of the detail design of structural steel parts for the composite ships being built by the Mobile Shipbuilding Co., Mobile, Ala.

M. J. HENOCH, chief building inspector, Sioux City, Iowa, has resigned to become superintendent of construction for the Davidson Realty Co. Mr. Henoch is secretary of the Civil Engineers' Society of Sioux City.

A. F. LEWIS, assistant city engineer, Schenectady, N. Y., has resigned to enter the ground school of the aviation section of the Signal Corps at Cornell University.

J. B. MCCLAIN has become bridge engineer of the Seaboard Air Line Ry., succeeding Guy Pinner, resigned. Mr. McClain was previously assistant bridge engineer; W. C. Binford succeeds him.

CHARLES A. LEE, assistant engineer, British Columbia Electric Co., Vancouver, B. C., has entered the United States Navy as a lieutenant in the civil engineering corps. Mr. Lee has been in the service of the British Columbia Electric Co. since 1909, engaged in hydro-electric developments.

OBITUARY

Died in the Service of Their Country

LIEUT. EDWARD HALE PERRY of the Sixth Engineers, U. S. A., was killed Mar. 30 in the battle in Picardy. It is believed that he was a member of a small party of American engineers who volunteered for emergency service with the command of Brigadier General Carey, which on Mar. 26 and the six days following, in fighting of the bitterest character against formidable odds, effectually blocked the German advance at one of the weakest parts of the British line, and closed the gateway to Amiens at that point. After his graduation from Harvard University in 1909, Lieutenant Perry studied in the Graduate Schools of Applied Science and in 1913 received the degree of M. E. He entered the Officers' Training School at Plattsburg in May, 1917, and later became a reserve officer in charge of mining and sapping.

LIEUT. ROBERT BRINTON HILL has been killed on the western front in the service of the British Royal Flying Corps, in which he enlisted in September, 1917. Immediately after his graduation from Towne Scientific School University of Pennsylvania, in 1914, Lieutenant Hill entered the service of the Portland Cement Assn. and became manager of the bureau of accidents and prevention work.

FREDERICK REMSEN HUTTON, honorary secretary of the United Engineering Society, and who was for 25 years Secretary of the American Society of Mechanical Engineers, died May 14 in New York, in his sixty-fifth year.

Professor Hutton was born in New York City and was graduated from Columbia University in 1873. From 1877 to 1907 he was professor of mechanical engineering at Columbia University and for six years he was dean of the faculty of applied science. He was the author of "Mechanical Engineering of Power and Plants," "Heat and Heat Engines," "The Gas Engine," and "Mechanical Engineering of Steam Power Plants."

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Cement Prices Fixed for Government Needs

Prices Previously Paid by Government Increased—Warning Against Advances to Public

The Government price-fixing committee has adjusted the relations between the cement industry and the Government, bringing about, broadly speaking, an increase in prices paid by the Government for cement, with the assertion that, if a disposition develops to advance this price to the general trade, the committee would be forced to establish a policy of fixing the price paid by the general public at that which is paid by the Government.

It is explained in Washington that the readjusted prices have been based on Federal trade reports, and that prior to May 1 the Government bought cement at less than commercial prices, namely, at 30c. less than commercial prices, 20c. less than the dealers' price. The prices which have been fixed are to be effective for the four months ending Aug. 3.

The following represent the new schedule of prices per barrel f. o. b. cars: Hudson, N. Y., 1.85; Northampton, Penn., 1.75; Universal, Penn., 1.75; Fordwick, Va., 1.70; Bellevue, Mich., 1.80; Mitchell, Ind., 1.70; Hannibal, Mo., 1.70; Buffington, Ind., 1.60; La Salle, Ill., 1.70; Mason City, Ia., 1.70; Iola, Kan., 1.75; Steelton, Minn., 1.70; Kingsport, Tenn., 1.65; Richard City, Tenn., 1.65; Harrys, Tex., 1.70; Houston, Tex., 1.80; El Paso, Tex., 1.95; San Antonio, Tex., 1.95; Trident, Mont., 1.90; Portland, Colo., 1.75; Devils Slide, Utah, 1.90; Brigham, Utah, 1.90; Salt Lake City, Utah, 1.90; Irvin, Wash., 1.95; Concrete, Wash., 1.95; Oswego, Ore., 2.00; Cement, Calif., 1.95; Davenport, Calif., 1.95; Crestmore, Calif., 1.95.

Shipments in bulk 15 cents per bbl. less.

Shipments in paper bags 10 cents per bbl. additional.

Shipments in cloth bags 40 cents per bbl. additional.

According to information obtained at the office of Richard L. Humphrey, chief of the commodities section, Council of National Defense, Washington, D. C., the Government price-fixing committee passed a resolution at its meeting May 4 which was handed to the cement manufacturers as notice of the Government's position in connection with maximum prices. The resolution follows:

"Whereas, the unknown quantities influencing the probable cost of cement during the four months ending Aug. 31 are so numerous as to make it difficult to fix a maximum price which will secure to the manufacturers what the Government considers a fair profit, it is understood and agreed that if at any time during said period for which maximum price has been fixed the manufacturers can submit a convincing proof to the price-fixing committee that the price agreed upon is unfair to them, the committee will receive such evidence and readjust prices from date of said submission of evidence on what the Government, following its usual policy, conceives to be fair and just to the manufacturers. While the maximum price agreed upon is understood to be for the Government only, the manufacturers have assured the Government that the maximum price they are charging the general trade is the list submitted to the Government on Apr. 22, with the exceptions noted on attached list. The Government serves notice on the manufacturers, however, that if there is any disposition to advance this price to the general trade, the Government will enforce the established policy of the Government where it fixes a price for the Government and the public, for the general public to pay the same price which the Government pays."

During the period from Jan. 1 to May 1, the Government was buying less than 5% of the cement production of the country, but the demand has steadily increased because of the growing necessity for using concrete in construction as a substitute for steel, which cannot be obtained in sufficient quantity in the present state of the market.

The members of the Government price-fixing committee are R. S. Brookings, chairman; B. M. Baruch, chairman of the War Industries Board, ex-officio; Hugh Frayne, representing labor; H. A. Garfield, representing the fuel administration; F. W. Taussig, representing the Tariff Commission; Lieut. Col. F. S. Young, representing the Army; Commander John M. Hancock, representing the Navy; W. B. Colver, representing the Federal Trade Commission, and H. B. Ingalls, acting secretary.

To Protect Consumers Against Poor Grades of Coal

The fuel administration has authorized the chairmen of the fuel committees of Lackawanna, Luzerne and Schuylkill Counties, Pennsylvania, to appoint coal inspectors for their respective districts. It will be the duty of the inspectors to condemn all consignments of coal which, in their opinion, are not merchantable, and to notify their respective chairmen of their action, stating the facts on which it is based and identifying the cars in which the condemned coal has been loaded. If the chairman approves the action of the inspector he will notify the operator and instruct him in regard to the disposition to be made of the condemned coal.

Cut in Rubber Imports by War Trade Board

Supply to Manufacturers of Non-War Products Restricted to Half of Consumption

The War Trade Board has announced restrictions on the importation of crude rubber which will limit manufacturers to a supply of approximately 7/16 of the average consumption during the calendar year of 1917, for other than war purposes. This is considered one of the most important steps taken by the War Trade Board in its program for making tonnage available for military needs by cutting down seaborne imports as far as is compatible with the interests and necessities of the country's industry.

The new order restricting imports of crude rubber will have a practical test during the next few months, to determine the sufficiency of the allotment decided upon. After a three-months' trial at the reduced ration, fixed at the rate of 25,000 tons per quarter, or 100,000 tons per annum, the War Trade Board will determine whether this quantity will suffice for the indispensable needs of the rubber industry, and will make the necessary adjustments should the amount fixed upon, after consultation with representatives of the trade, prove too large or too small.

No Hardship Expected

The order to restrict imports, of course, will not cut down the amount of rubber used in military contracts for the United States and the allied governments, so that the restriction will fall entirely upon producers of articles not destined for military use. It is not believed, however, that great hardship will be worked to the rubber industry and the consumer, in view of the fact that the stocks of crude rubber in this country at present are very large.

In the matter of distributing the future available supply of crude rubber from imports, the War Trade Board has taken steps to bring about an equitable allotment of supply to individual manufacturers, on the basis of 7/16 of the average consumption of each manufacturer during 1917. These measures have been taken to prevent possible attempts to corner the available supply. In arranging this method of allotment, the War Trade Board negotiated through the Rubber Assn. of America, Inc., which has been requested to communicate to all manufacturers and importers the details of the new regulations.

Find New Cleveland-New York Truck Route

All But 25 Miles Over State Roads—Distance, 585 Miles, Is Less Than Via Buffalo

Search made by the White Co. for a new motor truck route between Cleveland and New York, stimulated because heavy traffic on the Lincoln Highway and Mohawk Valley routes had made the roads impassable in many places, has recently been successful.

The route, mapped out after considerable scouting by R. H. Johnson of the White Co.'s New York office, is from New York through Liberty, Binghamton, Elmira, Hornell, Olean, Jamestown, Westfield and Erie to Cleveland.

Well-built hard-surfaced roads lead over the new route. It is stated that only 25 miles of road in the entire route are not improved state highways, and that even that distance is over good average road.

The new route, which is 585 miles long, is 80 miles shorter than the distance up the Hudson and through Buffalo, and but 30 miles longer than the Lincoln Highway route. The name "Liberty Highway" has been suggested for it by its discoverer.

Embargo Against Shipments to Philadelphia and Baltimore

A new embargo order went into effect yesterday, which said that domestic freight in carload lots will not be permitted to be shipped from outside points to freight stations, team tracks or private sidings in Philadelphia and Baltimore without special permits covering each individual shipment. The order was announced by the Philadelphia-Baltimore-Pittsburgh conference committee, of the national railroad administration. According to Samuel Rea, chairman of the conference committee, the embargo will probably be effective at least for the duration of the war. In order to prevent possible abuse of the permit privilege, the consignee instead of the shipper must secure a permit before freight will be allowed to go forward. The reason for this step is to insure prompt removal of the cars of freight received at these cities.

War Labor Board Forms Plans for Settlement of Disputes

The National War Labor Board has announced that definite plans have been formed for the settlement of local industrial disputes which might interfere with the war program. The plan provides for the appointment of local arbitration committees in industrial cities and districts, and of two-member subcommittees of the board itself to act in controversies which the local committee is unable to settle. These committees will be assisted by field agents sent from Washington to investigate each dispute.

The National War Labor Board will act as the court of last appeal, and will hear cases when its subcommittees are unable to settle them, or when one side or another makes an appeal from their decisions or those of the local committees.

Each subcommittee of the board will be composed of one member representing employers and one representing employees. Provision is made for the selection of an umpire who will render an award in case the board finds it impossible to reach a decision concerning a case which has been referred to it by the regular committees.

Jaws of Grab Bucket Close by Steam Power

Because a grab bucket of ordinary design will not work to advantage in ground containing buried sawmill refuse and slab wood, a contractor of Portland, Ore., tried out the idea of putting a small steam engine on the bucket itself to give a positive and direct action for closing the jaws independently of the hoisting line.

JAWS CLOSE BY STEAM POWER

The bucket has a capacity of 1¼ cu-yd. and has been provided with longer legs and a special head containing drums. One of these drums is geared to a crowding steam engine having two 5 x 6-in. cylinders mounted on one side of the bucket proper. The bucket is made up of 1-in. steel plate and has special manganese teeth, each of which is attached to the jaws by three or four 1-in. bolts.

The unusual feature of the device is the arrangement of the drums. The top shaft, which is gear-driven, carries a 12-in. and a 16-in. drum, while the lower shaft has 15-in. and a 14-in. drum. About 140 ft. of ¾-in. cable is wound on the drums, 70 ft. connecting each pair. This cable is wound so that as the upper shaft is driven by the engine, one upper drum and the diagonally opposite lower drum are always unwinding while the two others are winding up the cable.

Care has to be taken that the pull of these jaws is not carried by the hoisting line, as the power is more than enough to overturn the steam shovel. This power, however, is applied directly to closing the jaws and thus there is no tendency to slip or skid along slippery pieces of wood and the bucket is filled at each grab.

The device has been built and patented by C. J. Cook, contractor, Portland, Ore.

Business Notes

C. F. Gailor has resigned as president of the Atlantic Welding Co., New York, to enter the service of the Government.

R. E. Parks, assistant general manager of the Aluminum Co. of America at Maryville, Tenn., has become general manager of the company's plant at Badin, N. C.

H. D. Wright, manager of the San Francisco office, Brown Hoisting Machinery Co., has been appointed representative of the company for the Northwest territory, succeeding the Colby Engineering Company.

The Orenstein-Arthur Koppel Co., manufacturer of dredging and grading machinery and light railway equipment, is building a new plant at Koppel, a new industrial center which is developing just north of Pittsburgh. The Koppel Land Co., a subsidiary of the manufacturing company, is handling the land and housing developments of the new town.

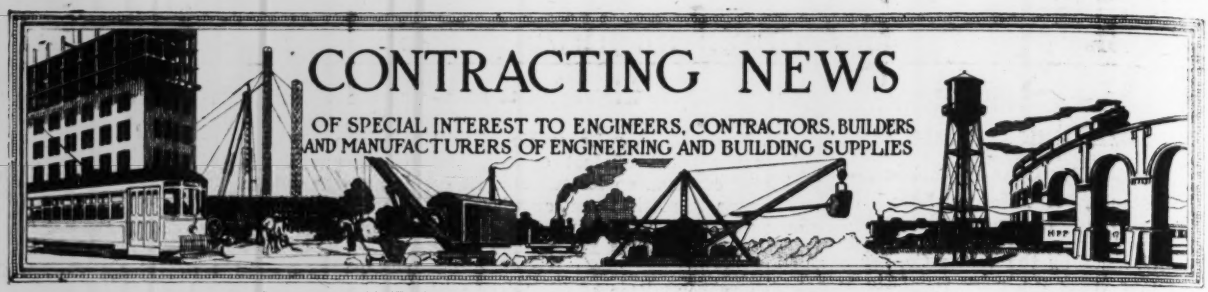
Trade Publications

The Blaw-Knox Co. has issued a new bulletin with the title, "Blaw-Single Line Clamshell Buckets."

The Lakewood Engineering Co., Cleveland, has published Bulletin 29, which contains illustrated descriptions of Lakewood equipment for building concrete roads, including complete plant.

A clear and interesting discussion of "trade acceptances" is presented in a 106-page book issued by the Irving National Bank, New York City. The book is entitled "Trade Acceptance Progress."

The Alexander Milburn Co., Baltimore, has published a new 47-page illustrated catalog containing descriptions of the various types of Milburn lights and acetylene outfits.


CONTRACTING NEWS
OF SPECIAL INTEREST TO ENGINEERS, CONTRACTORS, BUILDERS
AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES

Proposals

For Proposals Advertised See Pages 50-54 Inclusive

WATER-WORKS

Bids Close		See Eng. News-Record
May 20	New York, N. Y.	May 16
May 20	Providence, R. I.	May 16
May 22	Chicoutimi, Que.	Apr. 25
May 23	Charlotte, N. C.	May 16
May 27	Highland Park, Mich. Adv. May 16.	May 16
June 1	Miami, Okla.	May 16
June 3	Chaska, Minn.	May 16
June 3	St. Charles, Ill. Adv. May. 16	May 16

SEWERS

May 18	Martinsburg, W. Va.	Apr. 25
May 21	Columbus, O.	May 9
May 21	Kings Park, N. Y.	May 2
May 28	Columbus, O.	May 16
May 29	Shelbyville, Ky. Adv. May 9 and 16.	May 9
May 30	Rhinelander, Wis.	May 16
June 6	Chicago, Ill. Adv. May 9.	May 2

BRIDGES

May 14	Milton, Fla.	Apr. 25
May 17	Bayonne, N. J.	May 16
May 20	Charleston, W. Va.	Apr. 18
May 20	Rodeo, Cal.	May 9
May 20	Hobart, Okla.	May 9
May 21	Stockton, Cal.	May 16
May 23	Linton, N. D.	May 9
May 23	Flemington, N. J.	May 16
May 24	Walla Walla, Wash.	May 16
May 27	Uniontown, Pa.	May 9
May 28	Arden, Man.	May 16
May 30	Hoquiam, Wash.	May 16
May 31	Cincinnati, O.	May 16
May 31	Hohenwald, Tenn.	May 16
June 1	Forsyth, Mo.	May 2
June 1	Ada, Okla.	May 2
June 10	North Bend, Wis.	May 16
July 31	Santa Domingo Adv. May 16.	May 16

STREETS AND ROADS

May 17	Boston, Mass.	May 16
May 20	Everett, Wash.	May 9
May 20	New York, N. Y.	May 16
May 20	Seattle, Wash.	May 2
May 20	Washington	May 16
May 20.	Wyoming	May 16
May 21	Ashland, Wis.	May 16
May 21	Buffalo, N. Y.	May 9
May 21	Massachusetts	May 16
May 21	Tuscaloosa, Ala	May 2
May 21	Jersey City, N. J.	May 16
May 21	Michigan	May 16
May 22	Cleveland, O.	May 16
May 22	Florence, Ala.	May 9
May 22	New York, N. Y.	May 16
May 22	Union, N. J.	May 16
May 23	Freehold, N. J. Adv. May 16.	May 16
May 23	Montesano, Wash.	May 16
May 24	Jonesboro, Ark. Adv. May 2.	May 2
May 24	Uniontown, Pa.	May 9
May 27	Huntington, W. Va.	May 16

Bids Close		See Eng. News-Record
May 27	Mt. Vernon, Wash.	May 9
May 29	Garfield, N. J. Adv. May 16.	May 16
May 29.	Paterson, N. J.	May 16
May 29	Ridgefield, N. J. Adv. May 16.	May 16
May 29	New Jersey Adv. May 16.	May 16
May 29	White, N. J. Adv. May 16.	May 16
May 31.	Cincinnati, O.	May 16
May 31.	Ohio	May 16
May 31	Pennsylvania Adv. May 16.	May 16
June 1	Oswego, Kan.	Mar. 28
June 3	Marshall, Minn.	May 16
June 4	Pennsylvania Adv. May 16.	May 16
June 5	Greenfield, Ind.	May 16
June 6	Jefferson City, Mo.	May 2
June 31	Oswego, Kan.	May 16
Aug. 1	Cleveland, O.	Mar. 28

EXCAVATION AND DREDGING

May 20	New York, N. Y.	May 16
May 23	Greenville, Miss.	Apr. 18
June 4	Albany, N. Y. Adv. May 9 and 16.	May 9
July 10	Crenshaw, Miss.	May 16

INDUSTRIAL WORKS

May 23	Buffalo, N. Y.	May 16
May 25	Zanesville, O.	May 9
June 10	Brooklyn, N. Y.	May 16

BUILDINGS

May 20	Clintonville, Wis.	May 9
May 20	Ceylon, Minn.	May 2
May 20	Port Edwards, Wis.	May 2
May 20	South Amboy, N. J.	May 9
May 21	Baxter Spring, Kan.	May 16
May 21	Taylor Falls, Minn.	May 2
May 22	Clarksdale, Miss.	May 9
May 22	Salt Lake City, Utah	May 16
May 23	Story, Ia.	May 2
May 24	Mingo Junction, O.	May 16
May 25	Lander, Wyo.	May 16
May 27	Bagee, Miss.	May 9
May 27	Boston, Mass.	May 16
May 27	Ottawa, Ont.	May 16
May 27	Wellsville, O.	May 9
May 27	Wishek, N. D.	May 9
May 28	Union Grove, Wis.	May 2
May 30	Medicine Lake, S. D.	May 9
May 30	Princeton, Minn.	May 2
May 31	Tucson, Ariz.	May 16
June 1	Detroit, Mich.	May 2
June 3	Rockport, Ind.	May 2
June 3	Snowflake, Ariz.	May 16
June 5.	Morgantown, W. Va.	May 16
June 10.	New York, N. Y.	May 16
June 11	Akron, O.	May 16

FEDERAL GOVERNMENT WORK

May 17.	Laboratory—Bethesda, Md.	May 16
May 20	Foundation — Cape May, N. J.	May 16
May 20	Wharf and Trestle—Charleston, S. C.	
May 20	Employees Quarters No. 112—Klamath, Ore.	May 9
May 20	Nurses Quarters—Great Lakes, Ill.	May 9
May 20	Levee Work—Vicksburg, Miss.	May 9
May 20	Electric Lighting Plant—Washington, D. C.	May 9
May 20	Addition to Clothing Factory, Charleston, S. C.	May 9
May 20	Automatic Telephone System—Washington(D. C.	May 9
May 20	Electric Lighting System—Philadelphia, Pa.	May 9
May 20	Elevator—Mare Island, Cal. (Vallejo P. O.)	May 9
May 20	Magazine, Washington, D. C.	May 9
May 20	New and Additional Storehouses—Boston, Mass.	May 9
May 20	Radial Block Chimney—Norfolk, Va.	May 9
May 20	Revetment-Detroit, Mich. Adv. May 2.	May 2
May 20	Wooden Pier, Railroad Track and Storage Shed —New London, Conn.	May 9
May 20.	Coal and Ash Handling Equipment — Philadelphia, Pa.	May 16
May 20.	Boilers—Norfolk, Va.	May 16
May 20.	Power and 2 Transformer Houses — Philadelphia, Pa.	May 16
May 20.	Radio Buildings — San Diego, Cal.	May 16
May 20.	Foundation — Key West, Fla.	May 16
May 20.	Laboratory — Washington, D. C.	May 16
May 21	Culvert-Washington, D. C.	May 9
May 21	Levee Work—St. Louis, Mo. Adv. May 2.	May 2
May 23.	Pavements—Washington.	May 16
May 24	Building—Milwaukee, Wis. Adv. May 16.	May 16
May 24.	Pumping Unit — Washington, D. C.	May 16
May 25	Heating System—Phoenix, Ariz.	May 9
May 27	Administration Building, Blower House, etc.—Montauk, N. Y.	May 16
May 27	Buildings, Buffalo, N. Y. Adv. May 2.	May 2
May 27	Commandants' Quarters, etc.—San Diego, Cal.	May 9
May 27	Electric Duct System—Washington, D. C.	May 9
May 27	Electric Traveling Crane—Norfolk, Va.	May 16
May 27	Heating Plant — Great Lakes, Ill.	May 16
May 27	Intake Tunnel and Circulating Pump Installation —Portsmouth, N. H.	May 16
May 27	Nurses Quarters — Great Lakes, Ill.	May 16
May 27	Wharf—Boston, Mass.	May 9
May 27	Revetment—Kansas City, Mo.	May 9
May 27	Buildings—Washington, D. C.	May 9
May 27.	Fire Protection System—Pensacola, Fla.	May 16
May 27.	Electric Traveling Cranes, New York, N. Y.	May 16
May 27.	Electric Distributing System—Great Lakes, Ill.	May 16
May 27.	Paving Material, etc. — Washington, D. C.	May 16
May 30	Dispensary — Puget Sound (Bremerton P.O.), Wash.	Apr. 25
May 31.	Buildings and Tank — Savannah, Ga.	May 16
June 17	Commandant's Quarters, etc. —San Diego, Cal.	May 16

MISCELLANEOUS

May 20.	Spillway—Charleston, S. C.	May 16
May 21	Column Foundation — Brooklyn, N. Y.	May 9